April
1933

Construction Methods

This Month:

Lining 56-Ft. Diversion Tunnels at Hoover Dam

Ten Years of Sand-Asphalt Roads in North Carolina

Rogue River Bridge Decentered with Built-in Jacks

California Earthquake Damage and Repair

Placing 3-ft. concrete lining in invert of 56-ft. diversion tunnels at Hoover dam

YOUR OWN MEN CAN CUT COSTS

of gasolene, oil and maintenance with the help of CITIES SERVICE *Power Prover*

WHEREVER it is installed for contractors, the Cities Service POWER PROVER *works with* their maintenance men as a partner. It helps them do their work more efficiently, more accurately. It helps them produce and maintain the results expected of them—low operating and maintenance expense with minimum oil and gasolene consumption.

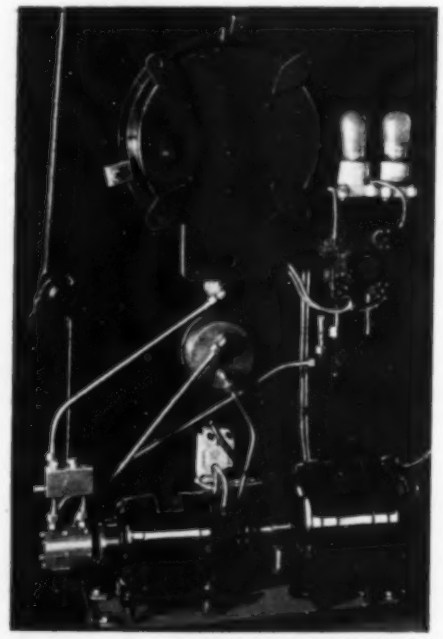
In the past year the maintenance staffs of more than 50 contractors have become enthusiastic over the assistance the POWER PROVER has given them. Step by step, during overhauls, this practical exhaust gas analyzer helps them check every adjustment in their tuning routine, with the result that all guesswork is eliminated. Motor tuning is made an exact science...definite economies and noticeable improvement result.

Why not give your maintenance staff the benefit of the POWER PROVER'S exact diagnosis of motor ills, and of the precision instruments of the Cities Service Tuning Routine? Cities Service engineers—world-famous combustion experts—will be glad to demonstrate *on your own* trucks, shovels, cranes, compressors, scrapers and tractors and with your own mechanics just what POWER PROVER service can do for you. There's no cost to you either for the demonstration or the service. Simply write to Cities Service POWER PROVER, Room 710, 60 Wall Street, New York City.

Radio Concerts—Fridays at 8 p.m., E.S.T., over WEAF and 32 N.B.C. stations

CITIES SERVICE OILS — ONCE - ALWAYS

The front view of the latest model Cities Service Power Prover, showing how simple it is to read and operate.



The rear view of the inside of the Cities Service Power Prover, showing its complex mechanism.

CITIES SERVICE POWER PROVER

Cities Service Oil Company • Crew Levick Company • Cities Service Refining Company
Louisiana Oil Refining Corporation • A. R. Newcombe Oil Company

Construction Methods

McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York

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Editorial Staff: Vincent B. Smith, J. I. Ballard (San Francisco) John W. Shaver (Cleveland), Nelle Fitzgerald

WILLARD CHEVALIER, Publishing Director

Beware of the Bargain Counter

• Timely, hard-headed advice on the selection and purchase of equipment is contained in Mr. Locher's article on successful contracting, elsewhere in this issue. In a buyer's market such as present conditions have created in the construction industry there is a temptation to attach undue importance to forcing down prices to bankruptcy levels and to neglect the important considerations of quality and dependability in the product purchased. Every contractor, of course, wants to keep costs down, but when he resorts to the extremes of "chiseling" he is apt to defeat his own best interests. Buying equipment is like purchasing anything else —you get just about the value you pay for. Experienced construction men know, as Mr. Locher points out convincingly, that proved, dependable equipment is not usually found on the bargain counter.

Steel for "Factoried" Houses

• Mass production methods applied to the building of houses at low cost has been the subject of recent widespread discussion. Advocates of the "factoried" house maintain that it can be produced in the way we now manufacture automobiles. Even though houses were factoried on the mass production principle, V. Gilmore Iden, of the American Institute of Steel Construction, points out that no evidence has been offered to indicate the practicability of marketing them. It would require a denser sale than is yet available for small houses to warrant the creation of local sales agencies similar to those established for the distribution of automobiles.

Speaking before the New Jersey Mason Dealers Association recently, Mr. Iden indicated some of the obstacles, commercial as well as engineering, that the mass production house encounters. Savings in labor on the factory-made house may be spent in the increased cost of hauling and lifting the completed structure to its foundations. Great savings are possible, however, in the factory production of standard units for walls and floors. Large floor units, stair units and wall slabs have been utilized and demonstrated as entirely feasible. These have been made of various materials—cement, gypsum, steel, wood and wall-board.

Efforts have been made and are still being made to produce a house with steel framing, somewhat after the accepted fashion of wood framing, that will compete in cost with houses of the same class built according to present standards of practice. Detailing and fabrication costs, however, have been excessive. With the introduction of welding, builders have been attempting to eliminate detailing and fabrication in the shop, but welding at the shop is still expensive. Nevertheless, when mill lengths are used and joints welded in the field, it has been possible to bring the cost down to approximately the cost of a wood frame.

Recently an all-welded "frameless" house was built to demonstrate the adaptability of sheet metal to low cost residential construction. Both floor and wall units of pressed steel sheets stiffened by box-like corrugations were sheared to length at the mill and assembled and welded in sections at the shop prior to delivery to the job. Further interesting developments in reducing costs and improving design and construction of steel buildings may be expected.

Too Many Hitch-Hikers

FUNDS in the form of motor vehicle fees and gasoline taxes, paid in good faith by automobile and truck owners solely for the building and maintenance of highways, are being diverted in increasing volume to almost any other purpose that the fancy of state legislatures may select. Last year, highway users and the road-building industry were short-changed to the tune of nearly $150,000,000. This is the substantial slice that was lopped from the nation's gas tax and vehicle registration receipts—rightfully a fund for road building only—and applied to general or special purposes entirely foreign to highway development.

Without even the formality of the usual thumb-wiggling plea, the financial hitch-hikers at our state capitals, brazenly and in increasing numbers, have been clambering aboard the highway fund car until it is now loaded to the breaking point. The consequent drastic curtailment of our road building program, a job-producing activity from which 91 cents of every dollar expended passes, directly or indirectly, as wages back into the pockets of labor, has forced thousands into the crowded ranks of the unemployed and compelled them to seek relief in doles and other dubious and humiliating forms of charity.

Unencumbered, highway development can proceed and pay its own way. It's time to paste a "No Riders" sticker on the windshield of road-building revenue.

Effects of 30-Hour Week

• Preliminary results of building highways under the limitations of the 30-hour week applying to labor on work under the terms of the Emergency Relief and Construction Act were reported recently by D. C. Levi, engineer of construction of the Missouri Highway Commission. A comparison of two-months periods before and after the 30-hour restriction became effective Sept. 1, 1932, on about half of the state's projects, shows an employment increase of 2,170 men or 18 per cent, in spite of a drop of 131, or 33 per cent, in the number of active projects.

From July 1 to Nov. 1 of last year total employment increased by 4,480 men, or 44 per cent, while the number of active projects dropped from 383 to 263, or 31 per cent. During the same period of 1931 employment decreased 2,171 men, or 29 per cent, while active projects declined 32 per cent.

"With the application of the 30-hour week," Mr. Levi concludes, "we have not only prevented the decline of 2,000 in number of employed men, but also have increased labor to the extent of more than 4,000 men during the same period of 1932. About 6,000 men, therefore, have had some measure of employment who otherwise would have had none."

Bridge Pylons of Sandstone

• Sandstone, not precast concrete, is the material forming the four pylons of the new Lorain-Carnegie bridge in Cleveland, illustrated on page 19 of our March issue. In correcting our error of statement, S. D. Knight, vice-president of the Cleveland Quarries Co., informs us that the pylons, with their eight large decorative figures, as well as the bridge rail, are products of his company's quarries, fabricated by its subsidiary, the Ohio Cut Stone Co.

For a Chiseling Holiday

CONFIDENCE, we are told, is the prime requisite for business recovery. We have it straight from bankers, industrialists, newspapers and public officials. There is plenty of money, they tell us, ample credit and a vast potential demand for all kinds of goods. All that we lack is confidence.

But how shall we build confidence under a relentless program of deflation? How can we restore confidence in the face of crumbling investments, shrinking employment and diminishing wages? Above all, how can confidence thrive under the blight of falling prices? For it is the price level that sets the measure of investments, employment and wages.

We all know that some adjustment to meet a new relation between supply and demand is inevitable. We know, too, that such adjustments, based upon revised costs, are essential to the general process of readjusting values. But here again demand will depend largely on confidence in the stability of prices. So we are caught in one of those circles of cause and effect which seem to whirl us about endlessly.

There is general agreement that substantial recovery must hinge in great measure on a resumption of capital investment. But capital does not seek investment unless business can earn a profit. And prices that are below costs do not breed profits.

From all of which it will be evident that the chiseling of prices to the destruction of profits is not a contribution to recovery. When it destroys profits it strikes down confidence, credit, employment and wages. It undermines the standards of quality and value upon which our industrial prosperity has been built. It dries up that incentive to progress and new enterprise from which alone revival can spring.

Confidence and chiseling cannot live in the same house; they cannot breathe the same air. They are utterly incompatible, for chiseling is blood-brother to fear.

The general contractor who bludgeons less-than-cost bids out of his sub-contractors, the horse-trading buyer who sweats manufacturers into red-ink prices, the public official who bluffs contractors into slashing rock-bottom bids, the newspaper that browbeats public officials into such destructive chiseling in the name of public economy: all these are trading on fear. They are not helping to build confidence; they are fostering further deflation, which, if it be not checked, can have no end short of national impoverishment.

In these times there is no excuse for such tactics. There need be no fear of excessive profits for anyone, manufacturer or contractor. The danger lies rather in maintaining the present regime of no profits at all. That is the way to general destruction.

Can we not have an end to these unreasoning attacks upon prices and values from whatever source? Can we not buy goods of established quality from reputable houses at honest and reasonable prices? Can we not lift buying and selling out of the cock-pit of mutual destruction and have them resume their normal function of fairly exchanging honest values? As buyers, can we not refrain from pitting seller against seller armed with the deadly spurs of price-only competition? As sellers, can we not resist the panicky temptation to bid in sure losses and thereby dissipate our capital in ruinous competition? If we could but do this for a short time, would not a revived and prosperous America offer ample opportunity for us all?

Sometimes we suspect that if all business would suspend for a period of six months the practice of buying at the lowest bid, and place its orders with those bidders whose prices most nearly meet the average of all the bids submitted, we might strike a body blow at deflation and start ourselves well on the road to recovery.

Impracticable? Perhaps. But none the less it is worth thinking about. At least it would declare a "chiseling holiday" and who can compute what that might be worth to all of us?

Gilbert Chevalier

Publishing Director

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ROADBUILDING *with profit!*

IN these times you can't make successful bids if you plan on using obsolete or worn-out equipment. Prices today must be figured too closely. There is no margin to take care of any loss in efficiency. But you *can* make job winning bids and make money on them by backing good management and hard work with up-to-date equipment selected for balanced value.

You need modern equipment for modern jobs and you need balanced value to cut costs to the bone. Before you bid your next job, investigate the savings possible with the new Bucyrus-Eries.

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BALANCED VALUE MEANS MOST FOR YOUR MONEY

BALANCED VALUE CUTS COSTS

All Sizes—½ yd. to 18 yds.
Shovels : Draglines : Dragshovels : Cranes
Clamshells : Dredges : Tower Excavators
Tunnel Shovels : "Loadmaster" Cranes
Bucyrus-Monighan Walking Draglines.
Gasoline : Diesel : Electric : Gas + Air : Steam
Dragline Buckets.

606

Do not purchase any machine — new or used — without careful study on all counts. Measure dependability, power, speed, operating efficiency and upkeep economy; weigh the reputation, experience and resources of the manufacturer.

BUCYRUS ERIE **SEE BUCYRUS-ERIE BEFORE YOU BUY!**

Zero Pressures give 30% more traction—*make big Savings in Gas*

IF you are entirely satisfied with your tractor's present performance . . . If you feel there is no room for improvement in operating efficiency — then this article will not interest you.

But if you want to get more work out of every tractor — more work in less time — and make important savings in gas and oil — get acquainted right now with this new type tire that contractors everywhere are adopting.

What is it?

It's the new Goodrich Zero Pressure tire and it's so far superior to old type tires that you can hardly believe what it saves you. Think of it — by simply putting Zero Pressures on your present equipment you'll add 30% more traction, 30% more power!

At the same time, Zero Pressures make the going so much easier that you actually use 18% to 20% less gas and oil on the job. So you save all around — save time — save power — save fuel — *save money!*

End tire troubles

Zero Pressures cross tire troubles off the list. They can't puncture — they can't blow out — they require absolutely no maintenance because they require no air pressure — they can't go flat.

Zero Pressures greatly out-wear all other type tires, too. Yet the cost is surprisingly low.

Send today

Wouldn't you like to learn more about this remarkable tire and how it will save you money? Then send today for the specially prepared booklet, "Goodrich Zero Pressure Tires" Address Dept. Z-12 The B. F. Goodrich Rubber Company, Akron, Ohio.

THEY *CAN'T* GO FLAT

Zero Pressure Advantages: Greater traction — no punctures or blow-outs — eliminates spinning — sinking. Saves gas and oil. Speeds up tractor operations. Gives uninterrupted, continuous service. Reduces tractor repairs — depreciation. Eliminates hazards of pneumatics — lighter than solids.

Goodrich *Zero Pressure* Tires

SPECIFY ZERO PRESSURE ON ALL YOUR MAINTAINERS

The New Blaw-Knox TRUKMIXER is the last word in all around efficiency, long life and low cost » » »

This is the unit that enables contractors, building supply dealers and ready mixed concrete plants to make worth while profits even with limited use. The Blaw-Knox TRUKMIXER is built to serve the average contractor's needs and is so economical that it is a paying investment even in a dull season. The TRUKMIXER is made to last; maintenance costs are practically eliminated.

A Blaw-Knox engineer can prove to you with figures taken from your own local conditions and set-up, that a TRUKMIXER will be a profitable investment. Will you ask for this demonstration even if you are only curious, there is no obligation involved.

The Blaw-Knox improved TRUKMIXER is made in the following sizes:—

AS A MIXER—1, 1½, 2, 3, 4 and 5 cubic yard capacities.

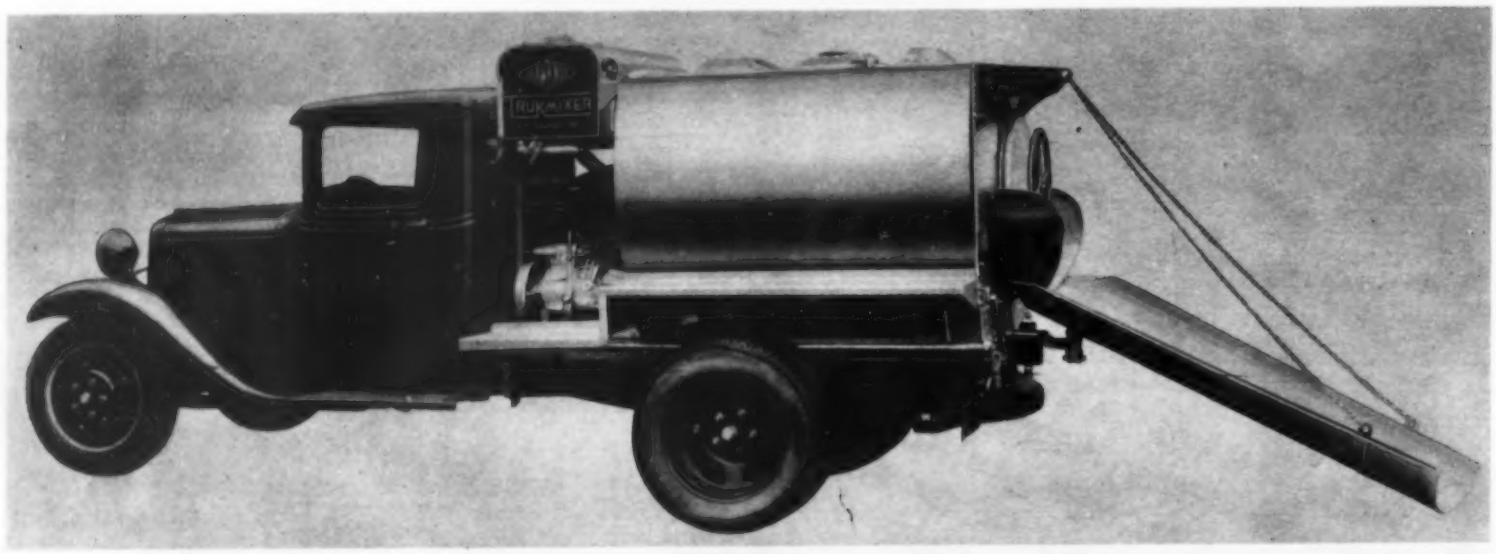
AS AN AGITATOR—1, 2, 3, 4, 6 and 7 to 8 cubic yard capacities.

Phone—wire or write

BLAW-KNOX COMPANY

2086 FARMERS BANK BUILDING PITTSBURGH, PA.

Offices and representatives in principal cities.



BLAW-KNOX

The Blaw-Knox Low Cost DIRTMOVER . . .

The song of the Blaw-Knox (Ateco) Hydraulic DIRTMOVER is **cheap dirt**, lower and lower cost per yard.

Yardage costs such as $.0495 per cubic yard, and lower, dependent upon length of haul—are a matter of common record. We would like to tell you about contractors who are making real money out of all kinds of dirt moving jobs.

Ask about the low cost DIRTMOVER.

The Blaw-Knox Hydraulic BULLDOZER . . .

—moves more dirt at less cost.

The rigid box type of construction conserves tractor power by an amazing reduction in Bulldozer weight without sacrifice of strength.

Easy and quick to put on—two way control, with positive downward pressure on the curved digging bowl—speedy bulldozing.

The hydraulic power which operates the digging bowl is concealed in the sidearm—away from dust and dirt.

Send for Bulletin No. 1394.

Other items of construction equipment in which Blaw-Knox leads.

Road Forms—Batcherplants—Clamshell Buckets—Steel Forms for Concrete Construction—Bulk Cement Plants—Ready Mixed Concrete Plants—Truck Mixers—Dirtmovers—Wagon Graders—Tamping Rollers—Bulldozers—Scarifiers—Concrete Buckets—Portable Asphalt Plants.

The through-and-through good Quality

of the LINK-BELT SHOVEL-CRANE-DRAGLINE

Writes its Story in Performance on the job

One of two Link-Belt shovels on a new California Road, (Ridge Route Alternate), through rugged mountainous country. A test of stamina and power.

Link-Belt K-55 dragline equipped with 65-ft. boom and 2-yd. bucket removing sand and gravel from river bed. 2,500 to 3,000 yds. loaded each 7½ hour shift.

Kingston Contracting Co., Luzerne, Pa., say, "We chose a Link-Belt shovel for our first stripping job and it proved so satisfactory that we have since purchased three more."

One of Mono Construction Company's two Link-Belt K-48 shovels excavating for a road over the crest of a dam—Bouquet Canyon. City of Los Angeles Water and Power Bureau.

Some of the Link-Belt draglines and belt conveyor equipment engaged in Mississippi River Levee Building work. Delivery to any desired point in the levee is accomplished by means of a bridge-mounted swinging boom belt conveyor. This equipment is establishing new low cost yardage records on levee building.

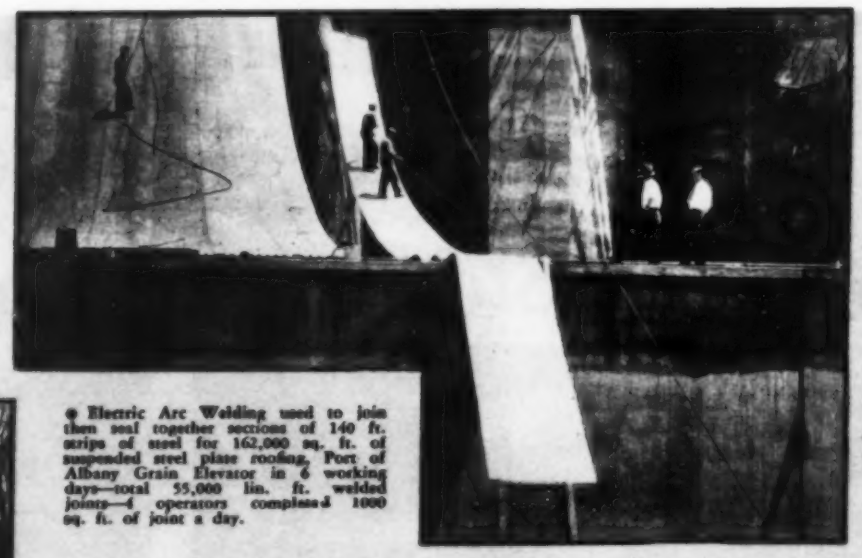
LINK-BELT COMPANY

300 West Pershing Road, Chicago, Offices and Distributors in All Principal Cities

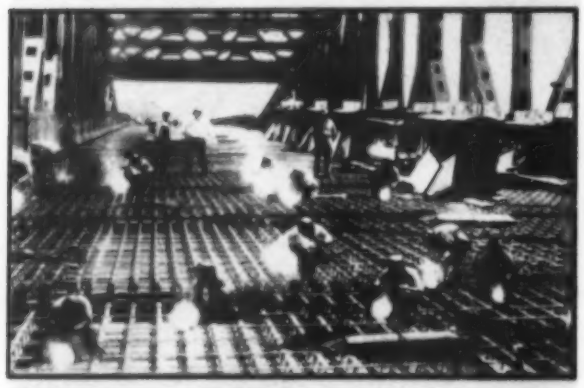
4700-A

SHOVELS CRANES LINK-BELT DRAG-LINES

● A new application of arc welding to the building of 40" Telescope Dome for Naval Observatory at Washington. Erected and completely Electric Arc Welded by J. K. Welding Company.



● Electric Arc Welding used to join then seal together sections of 140 ft. strips of steel for 162,000 sq. ft. of suspended steel plate roofing, Port of Albany Grain Elevator in 6 working days—total 55,000 lin. ft. welded joints—4 operators completed 1000 sq. ft. of joint a day.



● Electric Arc Welding the prefabricated mats of bar truss deck reinforcing to beams and stringers, for N. J. State Highway Viaduct. Total 925,000 sq. ft. fabricated mat on deck 50 ft. wide. All inter-sections of trusses with transverse bridging rods also welded.

● Strengthening N. Y., N. H. & H. bridge at Stamford, Conn. Adding top and bottom cover plates to girders under four tracks. Also reinforcing top girder angles at heel with gusset plates, railroad ties interfering. Top and bottom cover plates and gussets welded from underneath with practically no interruption of traffic.

Electric ARC WELDING *solves many problems*

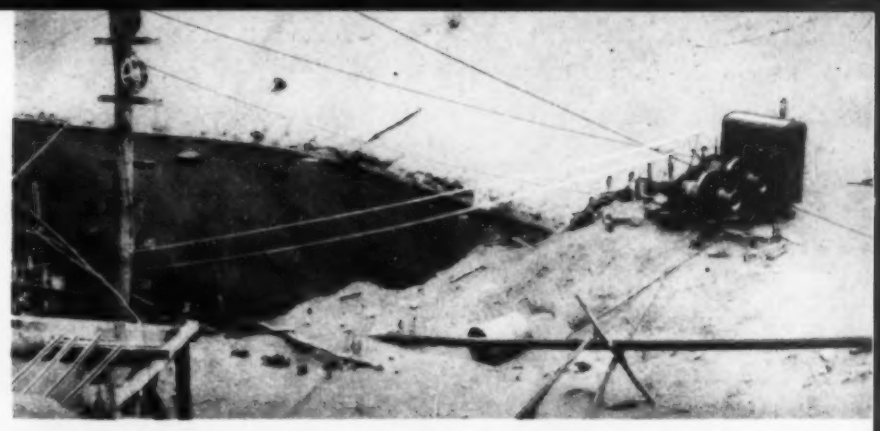
THESE photographs show the wide range of difficult and unusual welded construction on which "J. K." ELECTRIC ARC WELDING saved time and money.

Only with Electric Arc Welding as employed by the experienced and trained organization of the J. K. Welding Company would it have been possible to construct so economically and rapidly the great suspended roof of the Albany Grain Elevator and to place the deck reinforcing on the 3-mile N. J. State Highway Viaduct.

Electric Arc Welding, handled by experts, is the money-saving solution to many difficult construction problems. It was "J. K." experience and trained welding men that did these jobs—typical of what we can do on any work, large or small, anywhere. Bring us your problems and let us render you expert cooperative advice and service to show you how we can save you time and money as we have for thousands of others.

JK WELDING COMPANY INC.
4319 37th STREET, LONG ISLAND CITY, N. Y.

Novo lighting Plant (2 KW) used by the Holmes Construction Company at Wooster, Ohio, on Perry Highway, Pa., Route 246, furnishing light for night sub-grade crew. With a Novo Flud-Lighting Unit you can practically get daylight lighting all night long at a cost of only a few cents per hour, also power for operating small electric tools (Built in sizes from 1¼ to 15 KW).

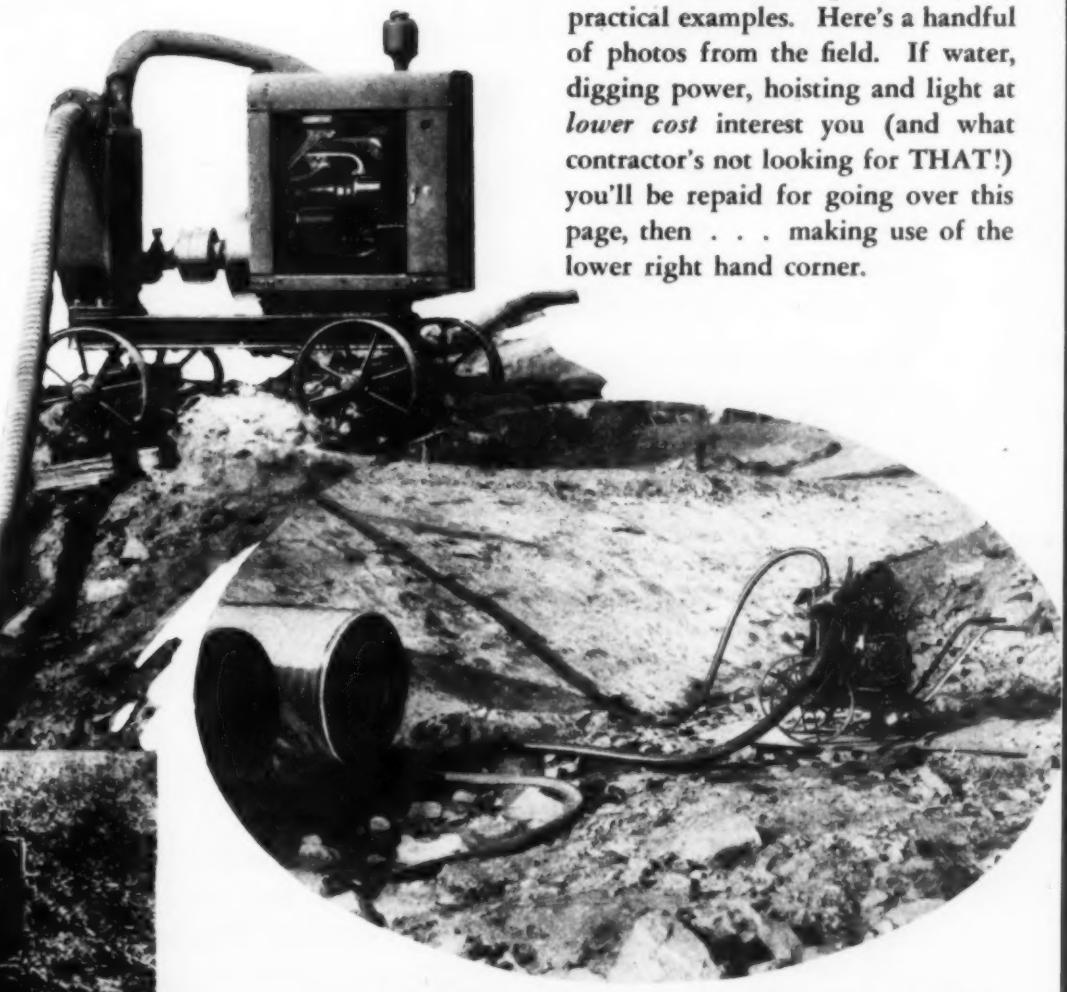


Novo Dragline Hoist owned by Scarlett & Earl, Inc., used in gravel pit near Lansing, Michigan. The Dragline outfit is taking out about 600 yards of aggregate a day using a 1 yard bucket. Excavating from in under the water with total lift of 45 ft. One man operated by remote control. Novo Dragline and Slackline Hoists are your answer to your digging, stripping, conveying and storing problems. (Sizes ranging from ½ cu.yd. capacity to 3 cu.yds.)

Novo News — *on Pumping, Digging, Lighting*

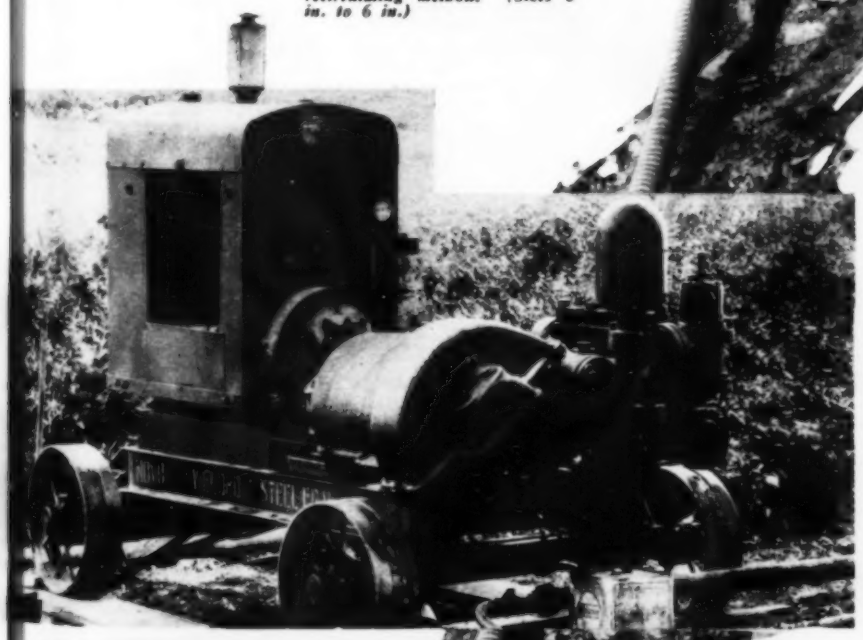
—stop a moment on these jobs and see how "the other fellow" is cutting costs and getting better results . . .

We can all learn—particularly by practical examples. Here's a handful of photos from the field. If water, digging power, hoisting and light at *lower cost* interest you (and what contractor's not looking for THAT!) you'll be repaid for going over this page, then . . . making use of the lower right hand corner.



Novo 2 in. Self Priming Centrifugal Pump. Owned by E. K. Porter, Carrollton, Mo. Used on State Highway construction. Capacity 7500 GPM. This pump has Novo's exclusive leather seal, requiring no attention and giving 100% air and water seal at all times. Equipped with handy hand trucks.

Novo 3 in. Self Priming Centrifugal Pump used on sewer job, City of Cedar Rapids, Iowa. Contractor is Christianson Construction Company. Novo Self Priming Centrifugal Pumps have the simplicity that you want—the perfectly plain pump case covers the only moving part, the impeller. Priming is by the sure recirculating method. (Sizes 2 in. to 6 in.)



This Novo Triplex Road Pump supplied water to a 27-E Paver which was laying as high as 1225 feet of 20 ft. concrete pavement a day, also supplying water for sprinkling and setting. The high speed operation of Novo Road Pumps means an even flow of water, eliminating that pipe wrecking water hammer. It is Flud-Oild lubricated. Novo's patented Water Governor holds the line pressure at all times, permits excess water to waste at the pump and allows engine to idle down when no water is being used.

Here is the handy way to get the data you want—just ✓ the item that interests you most—

NOVO

PUMPS — ENGINES — HOISTS

THIS COUPON BRINGS THE DETAILS YOU WANT

NOVO ENGINE COMPANY, 214 PORTER ST., LANSING, MICHIGAN
(New York, 243 Graybar Building) (Chicago, 3217 E. 92nd St.)

I'm interested in cutting the costs on my job.
I've checked below the printed matter to send me. Please send it to

Name ..... Address .....

- ☐ Novo Triplex Flud Oil Road Pumps.
- ☐ Novo Self Priming Centrifugal Pumps: 2" ☐, 2½" ☐, 3" ☐, 4" ☐, 6" ☐.
- ☐ Novo Pressure Pumps.
- ☐ Novo Roller Ring Plunger Pumps.
- ☐ Novo Flud-Lite Lighting Units.
- ☐ Novo Dragline and Slackline Excavating Hoists.

INTERNAL STRESS IN WIRE ROPE COSTS YOU MONEY

● WIRE ROPE is an assembly of wire strands twisted around a hemp core, each wire and strand forming a helix.

● With the old-fashioned way of making wire rope, the wires and then the strands go through machines which force the wires and strands to assume a helical shape . . . under tension like a bundle of compressed springs.

● COMMON SENSE TELLS US that a wire rope bound up with internal stress cannot combat bending fatigue and give the same wear as LAY-SET Preformed Wire Rope, in which wires and strands are preformed to their exact helical shapes. Preforming gives perfect strand adjustment and perfect strand balance. In LAY-SET, each wire and strand does its work relaxed and free from destructive internal spring-stress.

● ORDER LAY-SET Preformed Wire Rope now, so you will have it on hand for your next replacement. Tell us the make and type of your equipment, and we will be glad to make proper recommendations as to the rope best suited for your requirements.

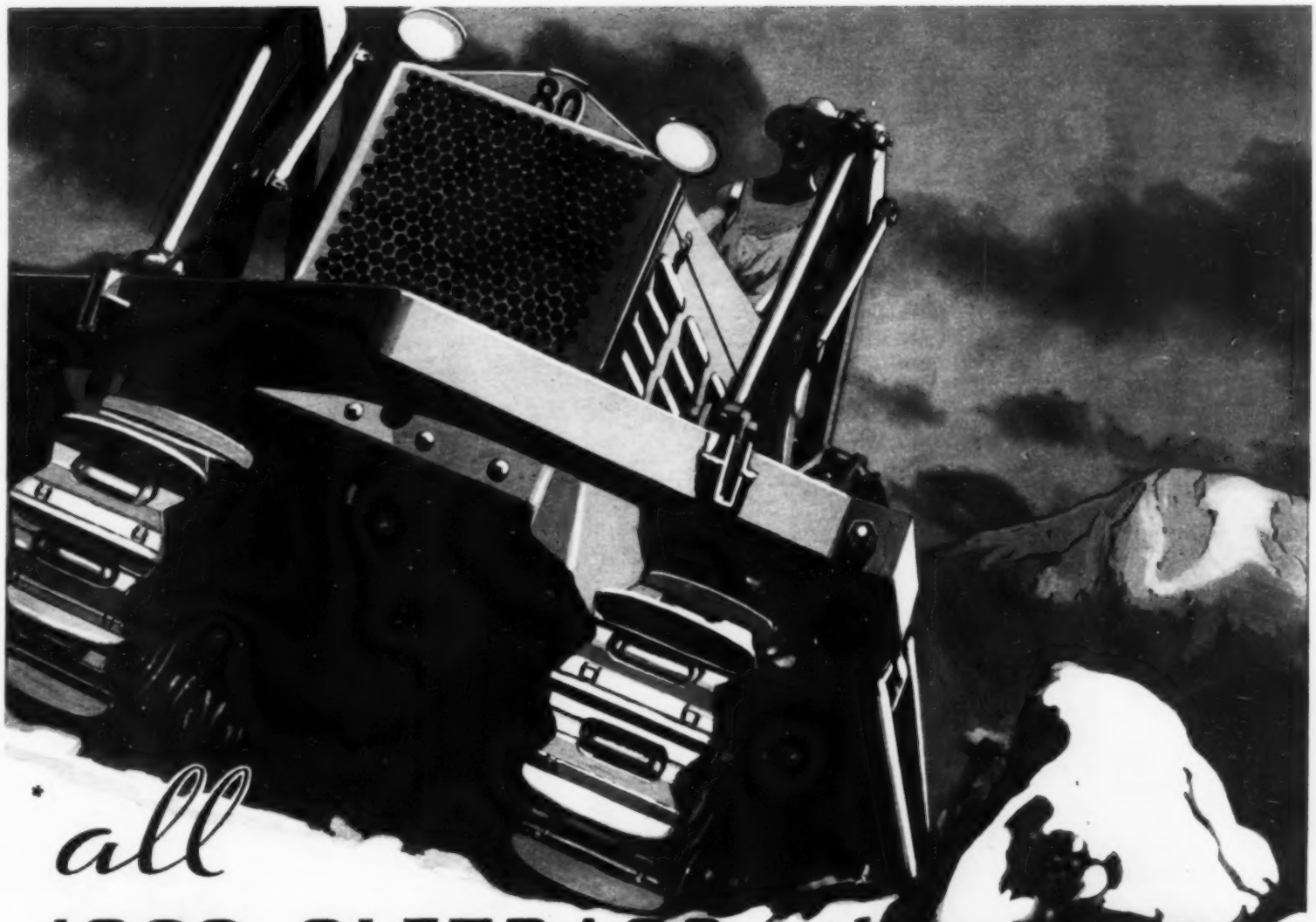
HAZARD WIRE ROPE COMPANY

WILKES-BARRE, PENNSYLVANIA

New York Pittsburgh Chicago Denver Fort Worth
Los Angeles San Francisco Birmingham Philadelphia Tacoma

● *Let us send you, without obligation, this illustrated booklet which tells in non-technical language 12 good reasons why* LAY-SET *gives much longer service.*

LAY·SET PREFORMED WIRE ROPE



all 1933 CLETRACS *are* 1938 MODELS

AS CLETRACS are today, so will other tractors be in 1938—five years from now. . . In 1938 Cletracs will be another five years in advance—setting new standards, rising to new heights of dynamic achievement. This is the history of Cletrac, as characteristic of Cletrac as dawn is of day. . . Today, Cletrac's design and performance are five years ahead because of 26 advanced mechanical features, 22 of them exclusive, including—

1—Controlled differential steering. U. S. patent No. Re. 14938.

2—All track wheel bearings sealed against sand, grit, dirt.

3—Centralized, continuous lubrication of all moving parts.

4—One-piece, heat-treated track shoes.

5—One-piece steel track frame.

- **Logging**
- **Oil Fields**
- **Agriculture**
- **Road Building**
- **Snow Removal**

Better Be Safe than Sorry. . . See what Cletrac Gives before You Buy. . . We make crawler tractors exclusively. Model 80 the world's most powerful automotive unit, and other horse power ratings of 55-35-25 and 15.

*The Los Angeles Fire Department fights encroaching forest fires with Cletrac 80.

THE CLEVELAND TRACTOR COMPANY
Cleveland, Ohio, U. S. A.

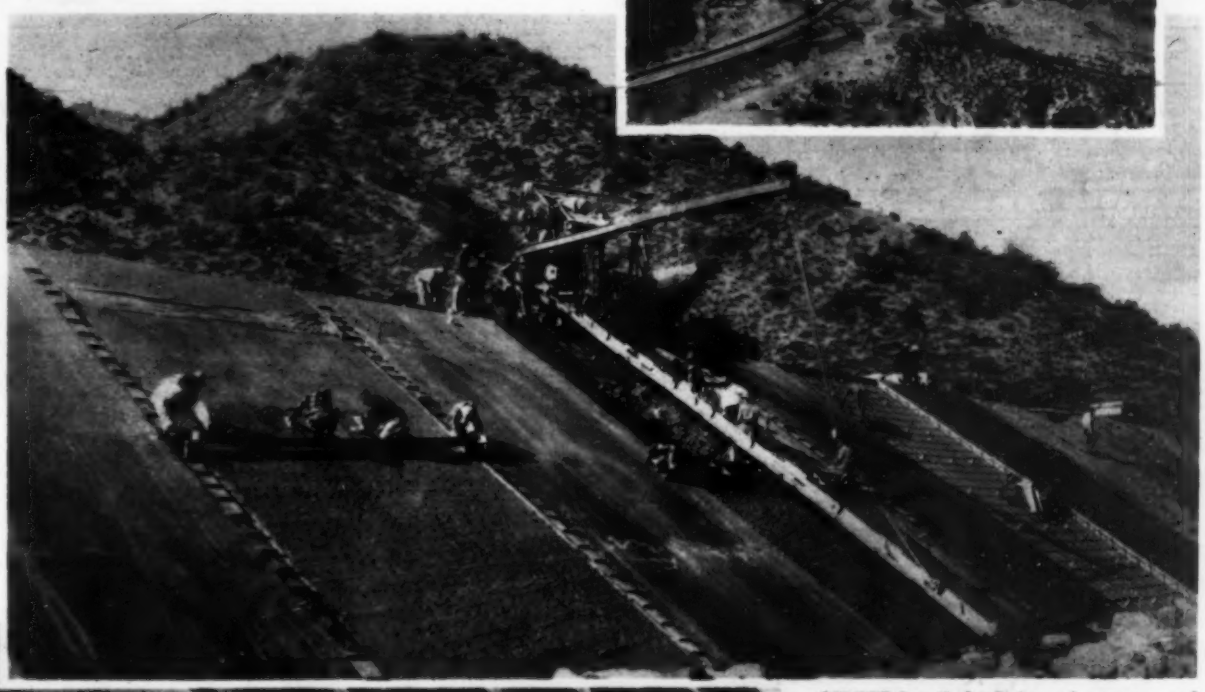
Cletrac Crawler Tractor
REG. U.S. PAT. OFF.
ITS MARK

Construction Methods

Established 1919—McGraw-Hill Publishing Company, Inc. ROBERT K. TOMLIN, Editor Volume 15—Number 4—New York, April, 1933

RIVER CHANNEL CHANGE

Saves Cost of Highway Bridges



TO avoid the necessity of building two bridges on a portion of California's new Alternate Ridge Route through mountainous country, the state's Division of Highways moved and shortened the channel of Piru Creek and diverted its flow into a waterway lined with concrete to prevent erosion. The velocity of the stream is dissipated at the lower end of the new concrete channel by deflecting the flow upward at an angle of 12½ deg., causing the water to pitch or "zoom" a distance of 60 ft. As compared with the estimated cost of two bridges where the highway route crossed the creek as originally located, the channel change, according to R. C. Myers, assistant engineer, District 7, effected a saving of $70,000.

The new concrete-lined channel varies from 40 to 90 ft. in bottom width and is 25 ft. deep. The concrete lining is 1 ft. thick for a distance of 16 ft. from the bottom, tapering off from that point to 6 in. at the top.

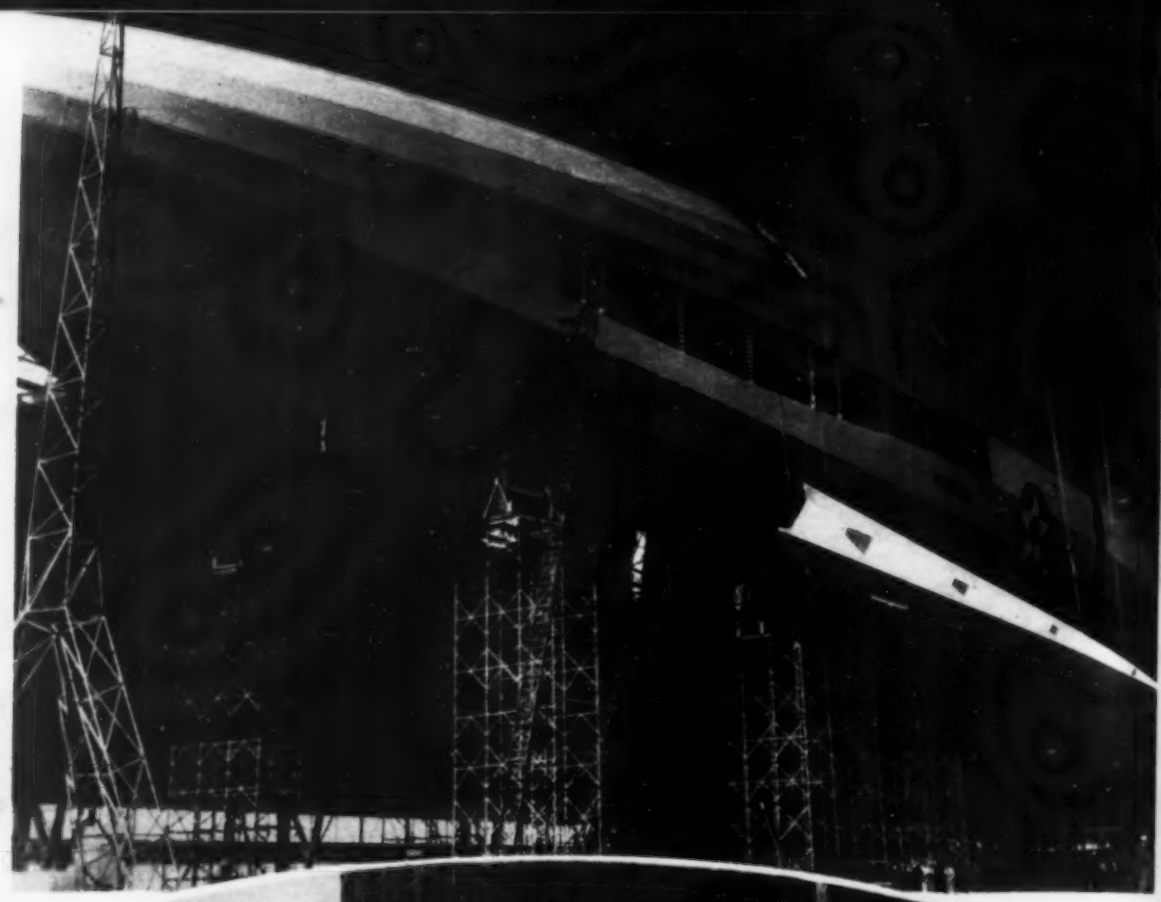
SCREEDS pulled up slopes by tractor and drum hoist smooth 20-ft. sections of concrete lining, poured through inclined chutes. RELOCATED CHANNEL *(at top)* saves cost of two highway bridges at locations marked by arrows.

CONCRETE TAKEOFF at downstream end of new channel deflects flow upward at 12½-deg. angle, reducing velocity by forcing water to make 60-ft. aerial leap.

Material excavated from the new channel by power shovels was hauled in trucks to form the nearby highway embankments. For the channel sides concrete, mixed in a Koehring 27-E paver, was poured through an inclined chute in sections 20 ft. wide and smoothed by a heavy screed pulled up the slope by a tractor and drum hoist. Two men rode the screed and filled in low spots to produce a uniform surface. Hand finishing was done from a bridge supported by cleats on inclined planks at the ends of each 20-ft. strip.

This Month's

"NEWS REEL"



DURALUMIN MEMBERS (*right*) form huge, lightweight structural framework of "Macon," Navy's biggest airship completed by Goodyear Zeppelin Corp. at Akron, Ohio, last month. Length, 785 ft.; maximum diameter, 140 ft.; gas volume, 6,500,000 cu.ft.; useful lift, 173,000 lb. Main transverse frames on 74-ft. centers are connected by longitudinal girders from bow to stern. Connections made by 6,500,000 duralumin rivets.

Keystone Photo

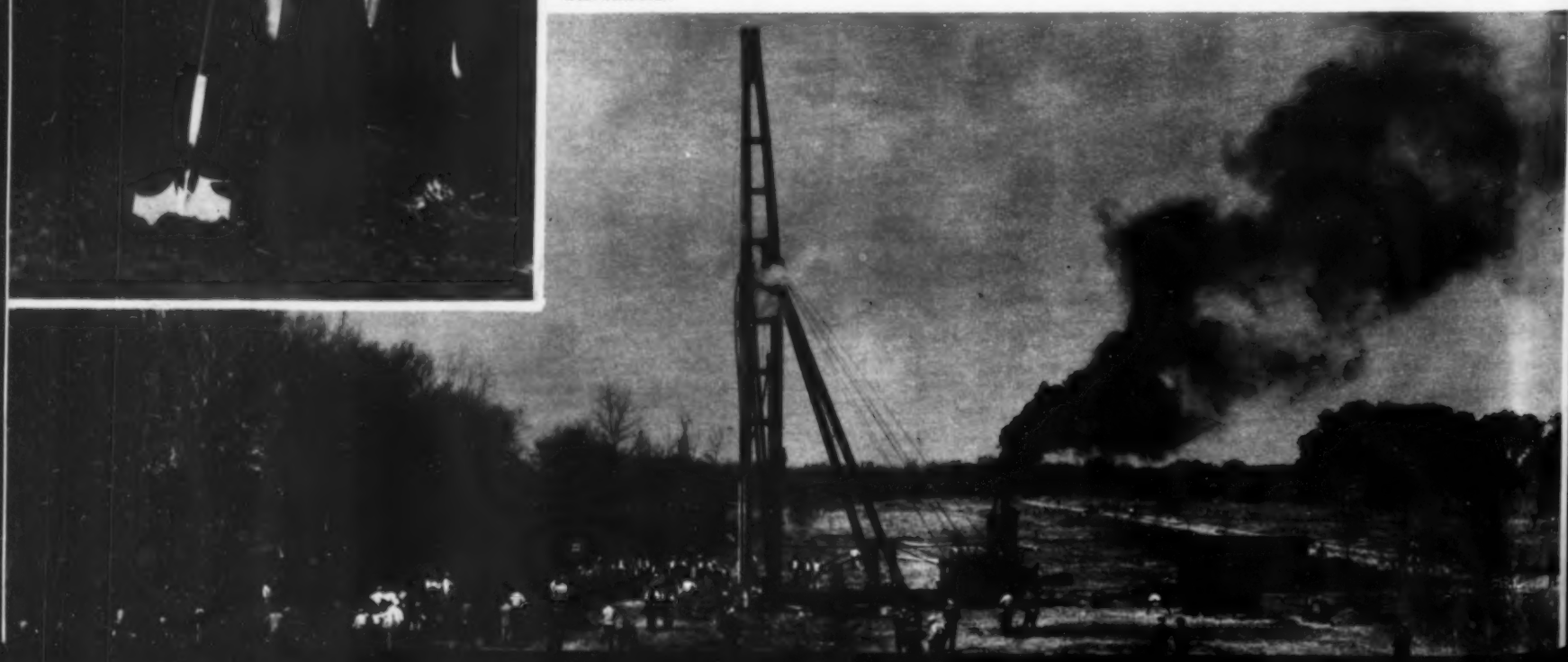
GOLDEN GATE BRIDGE construction (*below*) at San Francisco, is officially started by Mayor Angelo J. Rossi (*right*) and W. P. Filmer, president of bridge and highway district. Suspension structure with 4,200-ft. main span will cost $32,000,000. Total length 9,200 ft.

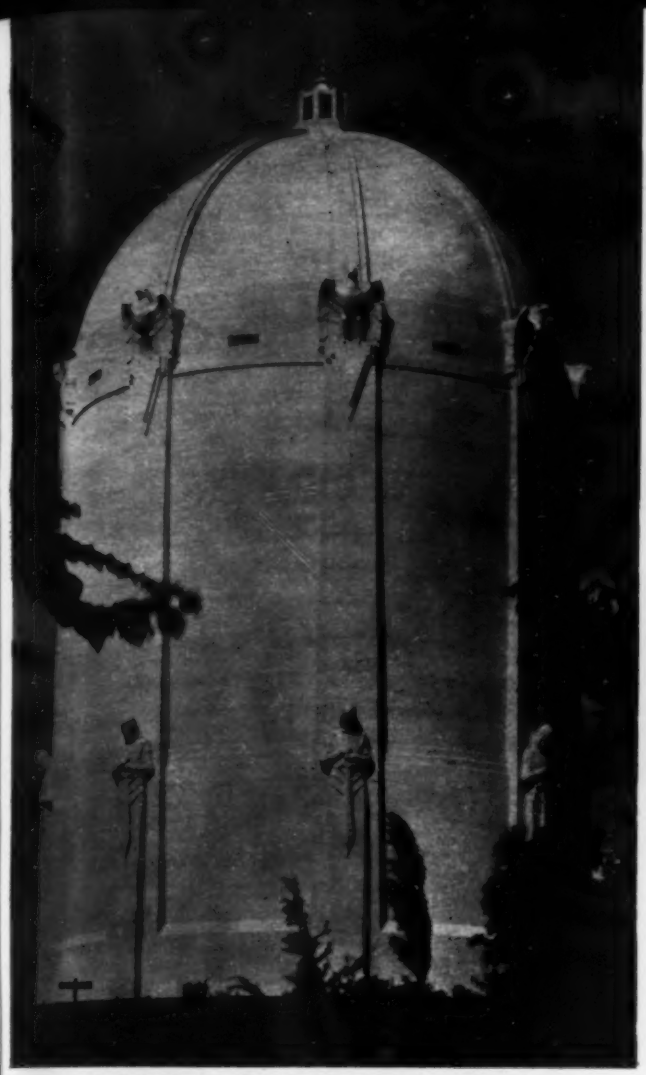
Wide World Photo

3.2 BEER SPURS CONSTRUCTION. Throughout country old plants are being remodeled or enlarged and new ones built. At Liebmann breweries, Brooklyn, N. Y. (*above*), work is being rushed on plant extension.

FIRST PILE (*below*) is driven by Macdonald Engineering Co., of Chicago, for approach substructure of $13,000,000 Huey P. Long bridge, public belt railroad and vehicular structure across Mississippi River at New Orleans, La., financed with aid of R.F.C. loan. For contractors A. O. McCurdy is field superintendent and G. M. Mixon office manager.

Wide World Photo



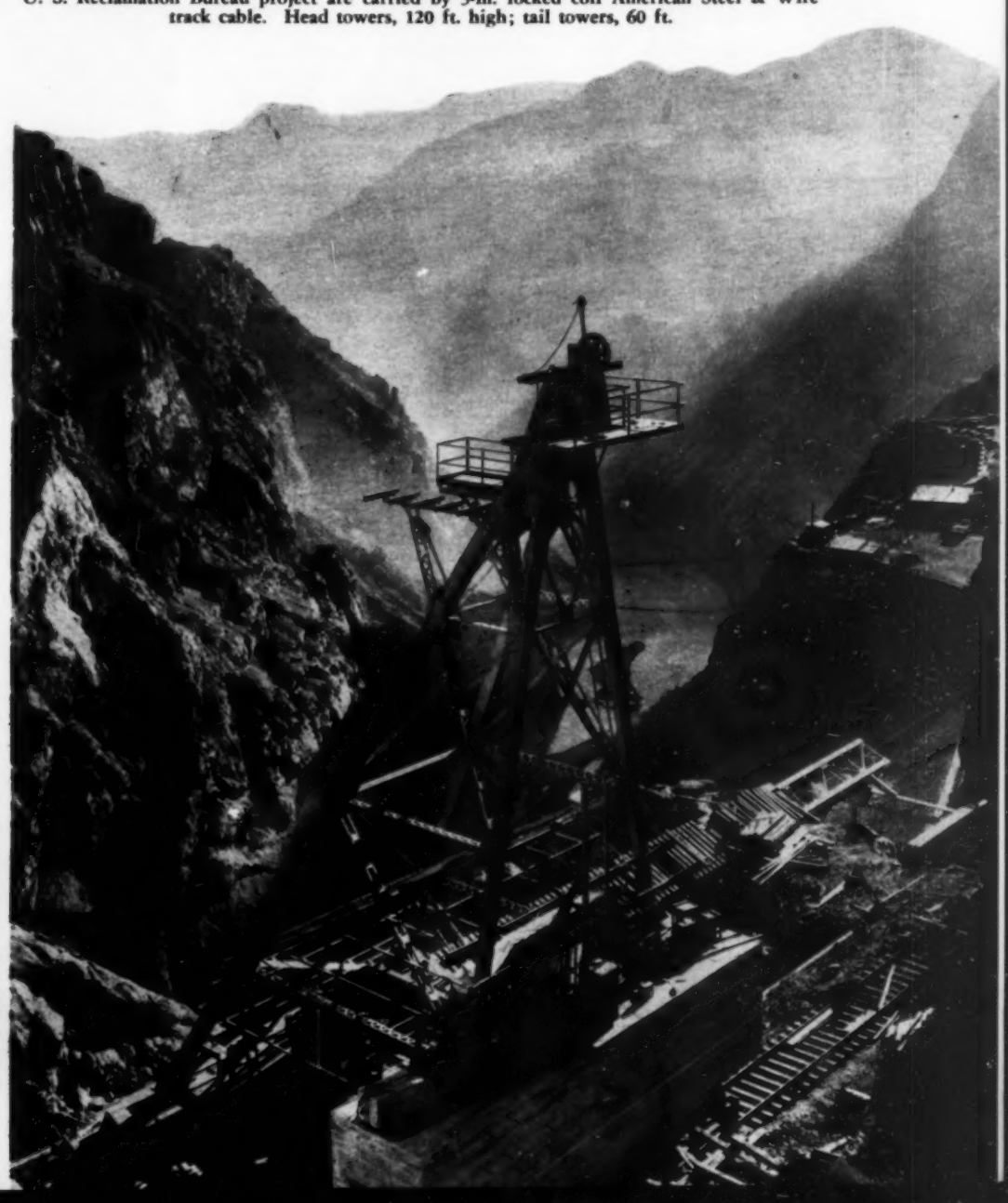


ORNAMENTAL WATER TOWER of reinforced concrete, holding 1,500,000 gal., is Minneapolis substitute for familiar standpipe eyesore. Height from floor to beacon light at top, 118 ft. Hewett design system prestresses concrete by circumferential steel. J. A. Jensen, engineer of waterworks.

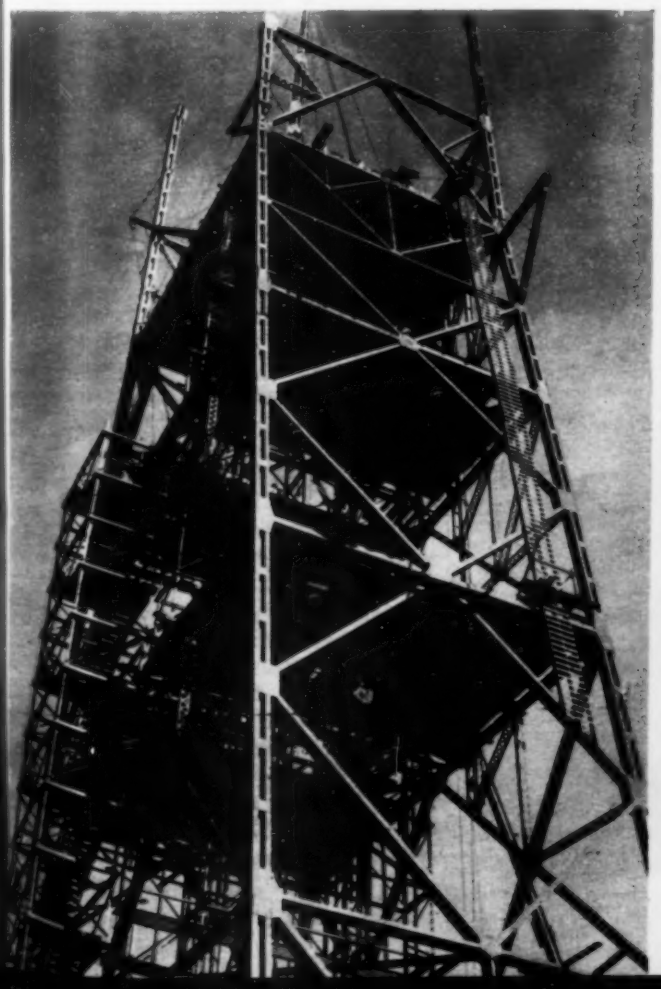
BELT CONVEYOR DISTRIBUTION of concrete is construction feature of Edgar Hoopes dam, built for Wilmington (Del.) Water Department (W. C. Wills, chief engineer) by John L. Walsh, of Northport Sand & Gravel Co., New York. Height, 135 ft.; length, 970 ft.; concrete yardage, 105,000; excavation yardage, 70,000.

Hercules Powder Co. Photo

HEAD TOWER (*below*) completed for one of five 20-ton Lidgerwood traveling cableways which Six Companies Inc. will operate across canyon of Colorado River at Hoover dam with spans of from 2,580 to 1,385 ft. Loads in handling rock excavation and concrete on U. S. Reclamation Bureau project are carried by 3-in. locked coil American Steel & Wire track cable. Head towers, 120 ft. high; tail towers, 60 ft.



SKY RIDE TOWER (*below*) for Chicago's Century of Progress Exposition extends up toward its 625-ft.-high top. Structure to give World's Fair patrons thrilling aerial trip in "rocket" cars will cost $1,000,000 and carry 5,000 passengers per hour.

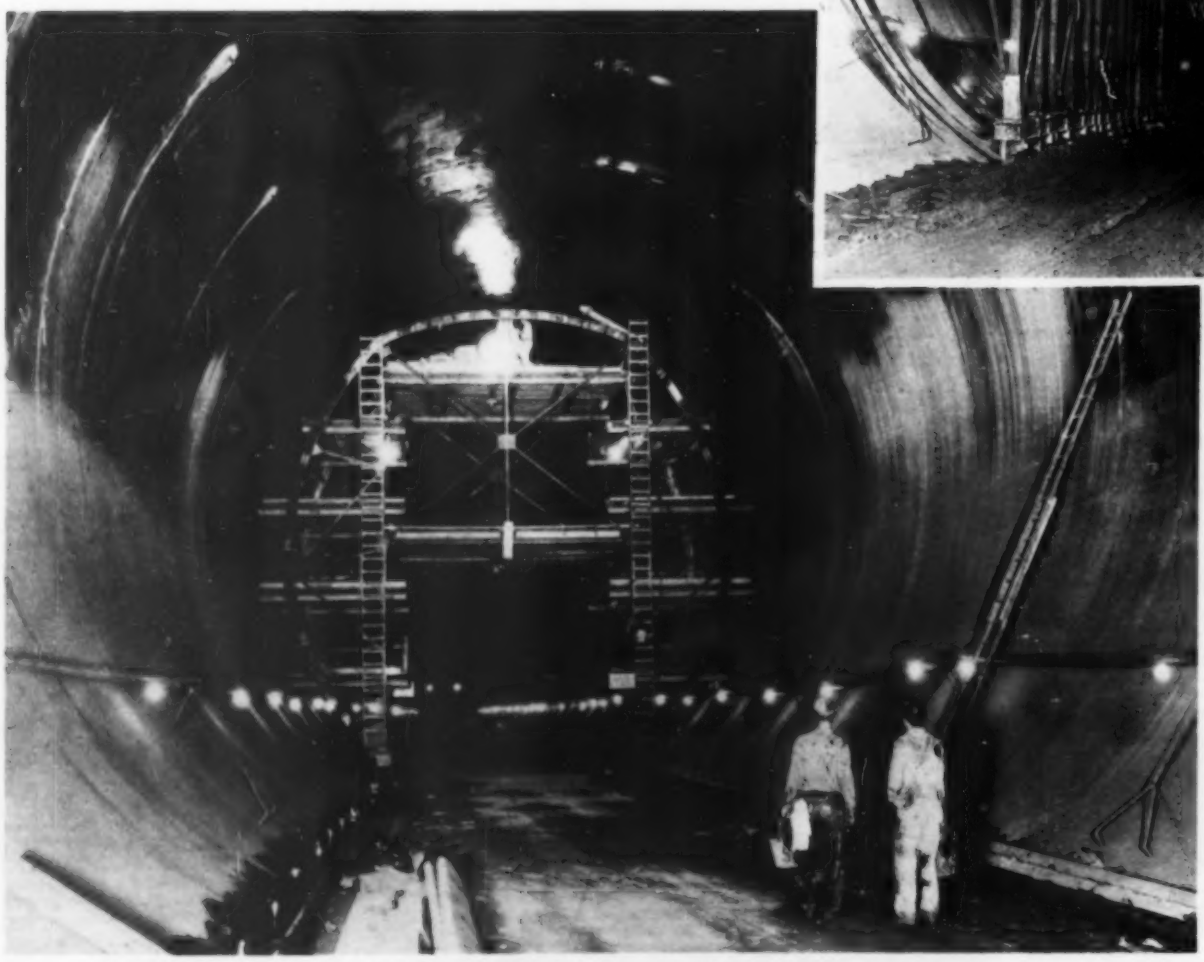


DIVERSION TUNNELS
at Hoover Dam
LINED WITH CONCRETE

Four 56-Ft. Rock Bores Finished With Cylindrical Coating 3 Ft. Thick, Requiring 300,000 Cu. Yd. of Concrete, Placed Behind Special Forms

LINING the 16,000 lin.-ft. of 56-ft. diameter diversion tunnels for Hoover dam constituted the major construction operation during the last half of 1932. The work involved placing 300,000 cu.yd. of concrete in the 3-ft. thickness of lining and was carried forward at the rate of 2,300 cu.yd. per day for weeks at a time. The first step in the lining process was started before tunnel driving was completed and the work accelerated to the peak in July, when 65,580 cu.yd. (gross) was placed. Designing of forms and equipment and the method of carrying out the steps in the lining process provided as many innovations as did the work of driving the tunnels, described in *Construction Methods'* Hoover Dam Number, published August, 1932.

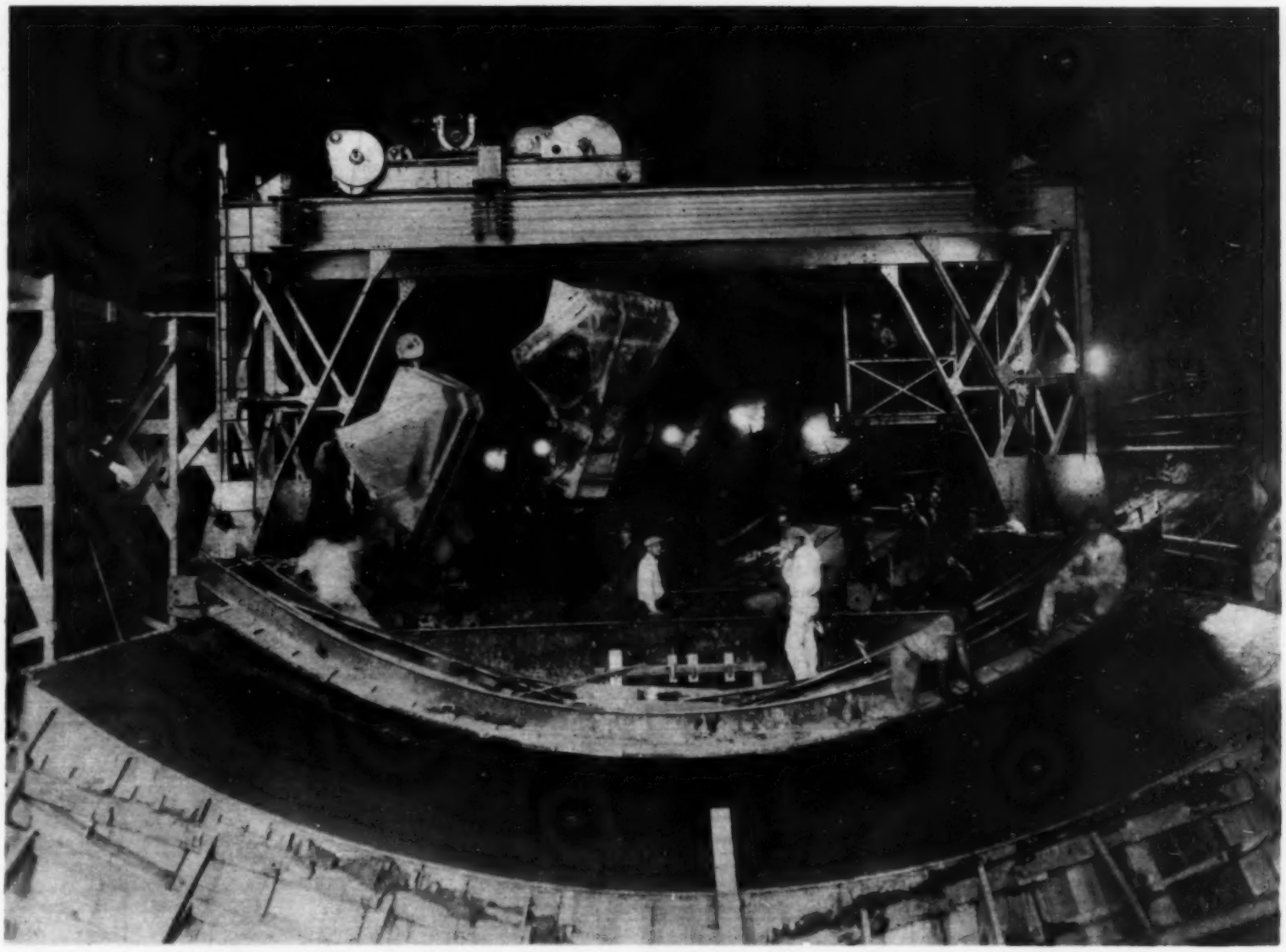
STEEL FRAME CARRIAGE supports forms for 110-deg. arch section of 56-ft. diameter tunnel lining. Jacks and wedges adjust forms.



LOW PRESSURE GROUTING is done through holes in arch section from platform on traveling steel frame carriage. Concrete is cured by spraying bituminous film on surface.

Preliminary—To permit uninterrupted lining operations during the summer flood season of 1932, concrete arch cofferdams were provided at the upstream and downstream portals of the four diversion tunnels. The foundations of these dams were constructed during the winter months, and the arches were carried up prior to flood stage. Trucking operations were continued over these cofferdams by means of fills of tunnel spoil on the outside and long timber ramps to invert level on the inside.

The flood peak of the 1932 season provided a discharge of 103,500 sec.-ft. in the canyon on May 27, which was a discharge equaling the record for several previous years, but far below the floods that could be ex-

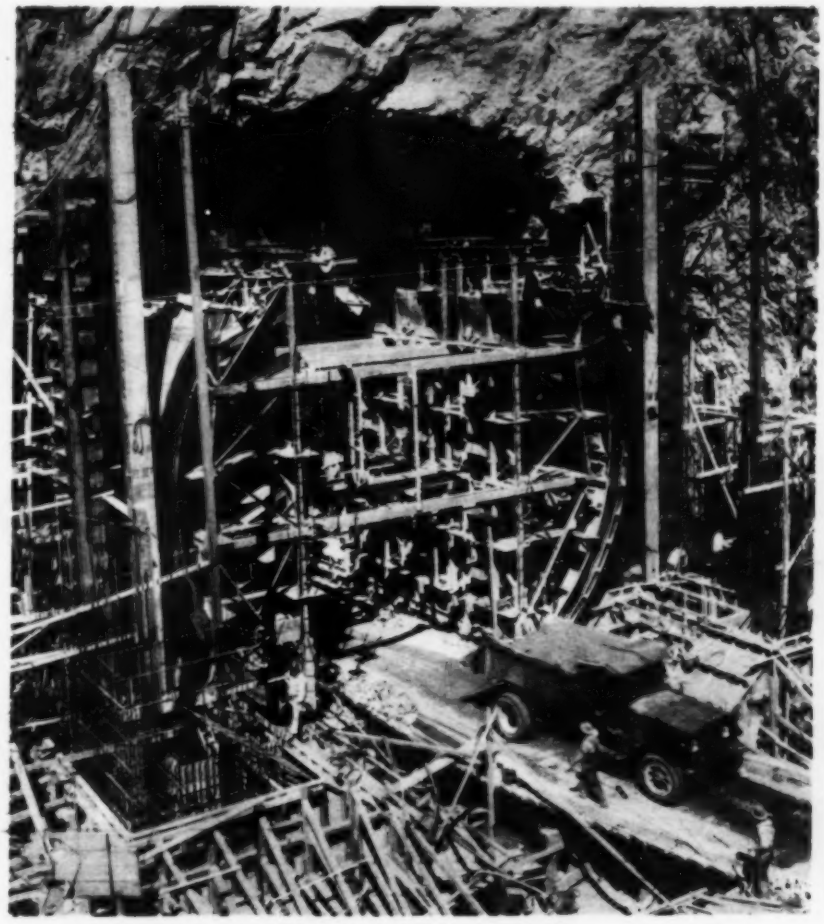


TRAVELING GANTRY, electrically operated, picks up 2-yd. concrete buckets delivered by motor trucks and deposits their contents between forms for invert section. Screeding is done from steel bridge curved to tunnel radius.

pected. Although the arch dams had been provided with steel uprights in their crests for adding 5 ft. of timber flashboards, the flood level reached an elevation 5 ft. below the top of the concrete. This protection of the tunnels was successful in permitting uninterrupted tunnel lining operations. The arch dams were removed by blasting when the lining was completed.

The other preliminary to the placing of invert concrete in the tunnels was the construction of continuous concrete shelves, or rail supports, along the upper edge of the invert section to carry the invert gantry. These concrete shelves were poured directly against the rock wall behind a timber form and were about 3 ft. wide on top by 2 ft. high on the vertical side. Timber stringers (6x12 in.) were bolted to this concrete and carried 90-lb. railroad rail on a 34 ft. 8-in. gage. Care was used in establishing the line and grade of the first supporting members since their position determined the base for all lining operations. The lining was permitted to have a tolerance of ¼ in. in line and grade.

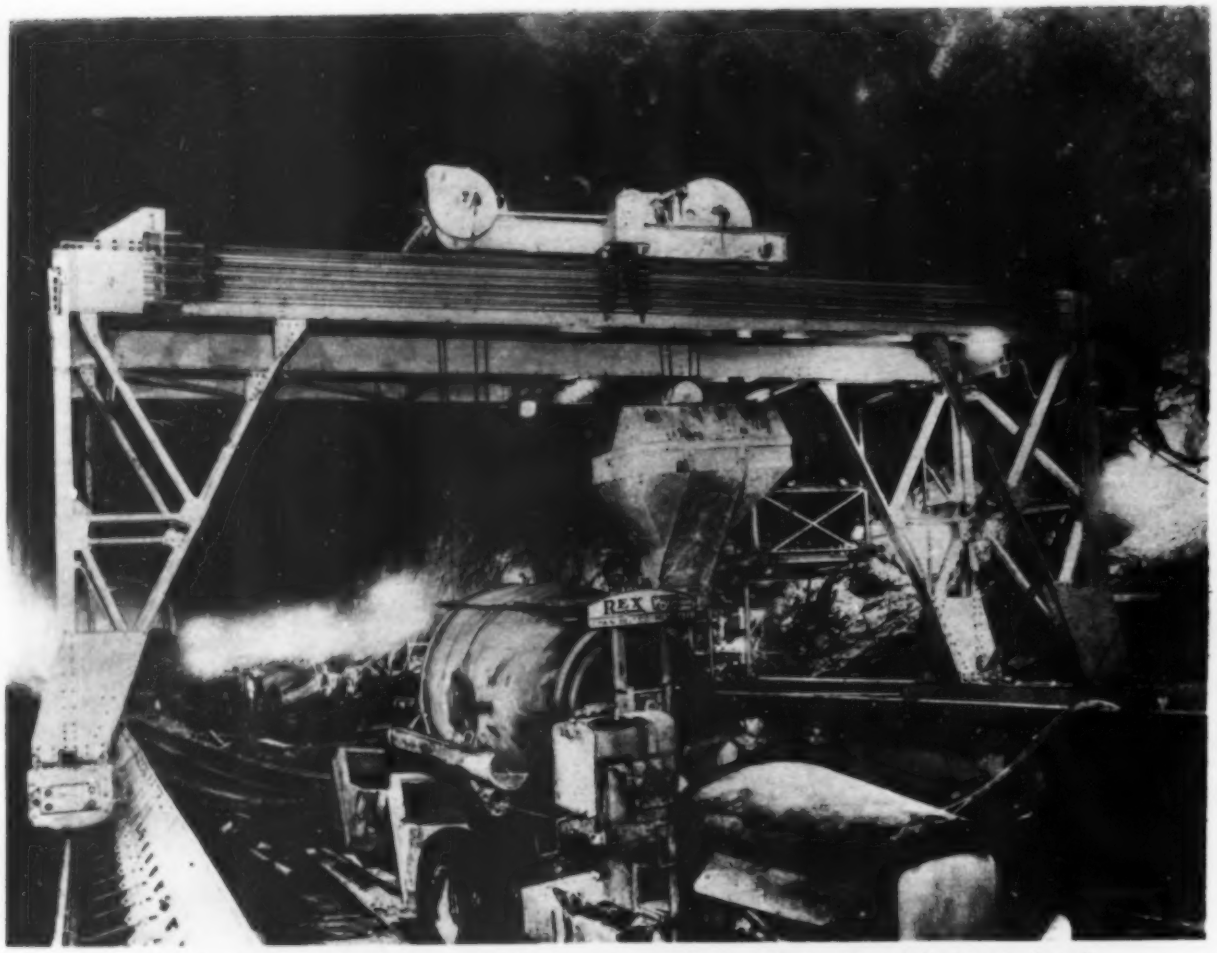
Invert Concreting—On the track operated a structural steel gantry which handled the concrete, forms



and equipment for the invert section. The invert section contained 75 deg. of arc and involved 3.8 cu.yd. of concrete per foot of tunnel, net yardage. The invert gantry supported an electric crane about 20 ft. above the invert elevation which operated two 5-ton hooks in addition to motors providing for moving the bridge and gantry. Electric equipment, operated on 440 volts, was supplied through a 500-ft. length of rubber-covered cable supported in a timber trough along the wall, permitting a 1,000-ft. run of gantry.

The frame provided clearance for handling concrete buckets, movement of trucks and all finishing operations. Concrete was trucked into the tunnels to these gantry cranes and then deposited in the invert. The use of 2-cu.yd. form buckets to take the output of each 4-yd. concrete mixer was tried at the beginning of the work where short hauls were the rule but difficulty was experienced in packing and clogging of the discharge and later agitator mixer bodies of 4-cu.yd. capacity were substituted and used

BULKHEAD GATE *(left)* **is being constructed at upstream portal of diversion tunnel No. 1.**



DELIVERY of CONCRETE for placement in invert section by traveling gantry and buckets is done by 4-yd. Rex agitator bodies on motor trucks.

for the major part of the lining operations. Mixing was completed at the plant, and the agitator feature of the bodies was used only during discharge or in case a traffic tie-up interrupted the schedule of delivery.

On arrival at the gantry the 2-yd. buckets were picked up off the trucks, or filled from the agitator truck bodies, depending on the method of transportation in use, and deposited in the invert section. As soon as sufficient concrete had been deposited on the bottom of the tunnel, screeds supported on a steel bridge curved to tunnel radius were pulled outward from the center by hand winches to strike off the concrete. This operation was supplemented by finishing with wooden floats and troweling. All finishing was carried on from light steel bridges and equipment was moved forward by means of the gantry.

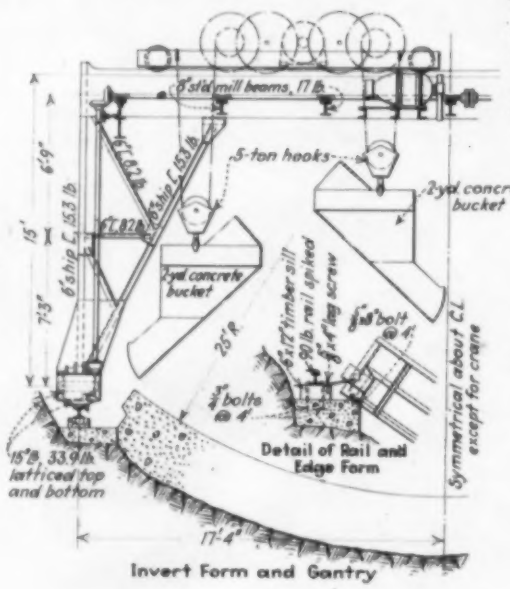
Side-Wall Concreting—Two incidental operations were then required, after finishing the invert section, before work could be started on the placing of the side walls. First, new rail supports of concrete shelves were poured on the invert concrete and the railroad rails moved over on to these new supports. This new track supported the side wall and arch forms. The original invert shelves were buried and formed a part of the lining concrete, but the second set of shelves was required to be removed in the lower sections of the tunnels where they will be in permanent operation.

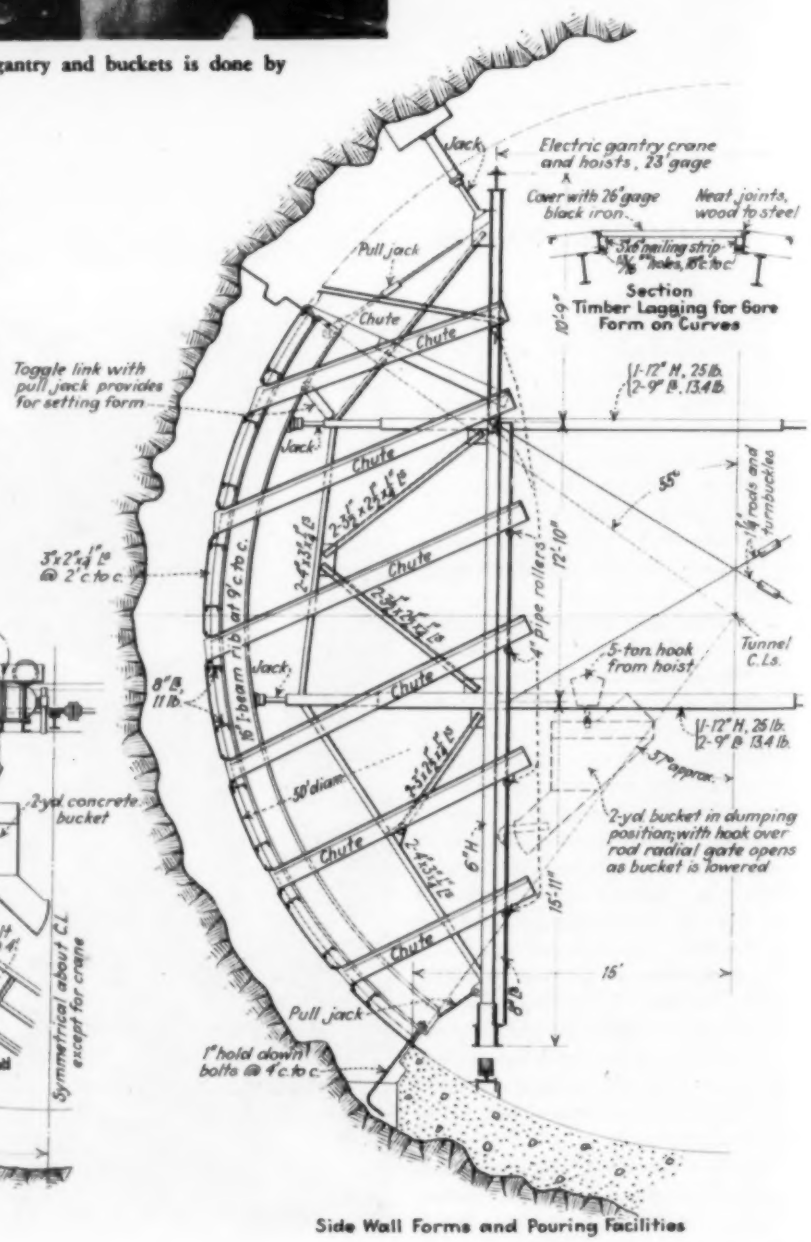
Second, protection of the invert concrete was required because all lining operations were carried forward from the upstream ends of the tunnels where the concrete plant was located. This protection was provided by backfilling with fine rock spoil end-dumped from trucks to provide a 25-ft. width of level roadway extending between the rails that supported the side-wall forms. This material averaged about 2¼ cu.yd. per linear foot of tunnel, provided a roadway, protected the invert concrete and assisted in curing. After lining operations were completed this backfill was removed by a shovel operating on pads, loading into trucks.

Forms for Side Walls—Forms for placing of the side-wall lining were gigantic, structural steel supports providing forms for the lining and supports for the gantry hoist. Each form unit provided for an 80-ft. length of lining and weighed, when completely equipped with crane, about 270 tons. These units were moved along the rails by air-operated hoists. In addition to the strength required to support the side wall concrete, it was necessary that these forms provide ample clearance for uninterrupted trucking operations underneath.

Provisions in the specifications required that concrete could not be dropped more than 5 ft. vertically into the forms and should not flow more than 5 ft. in a horizontal direction. This necessitated an extensive

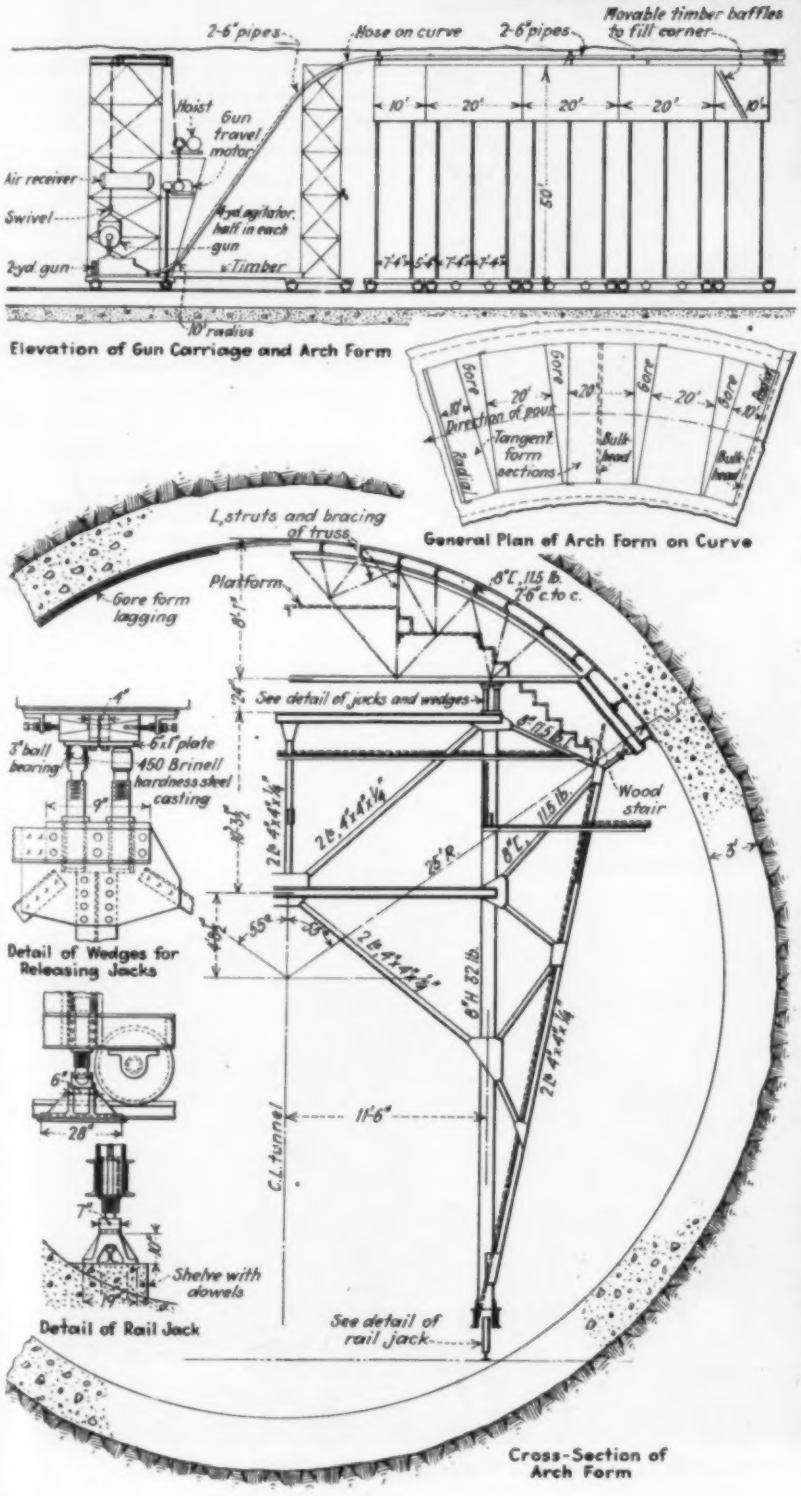
DETAILS of rail support for traveling gantry and invert forms *(left)* and of side-wall forms *(right)*, showing inclined chutes for delivery of concrete for tunnel lining.





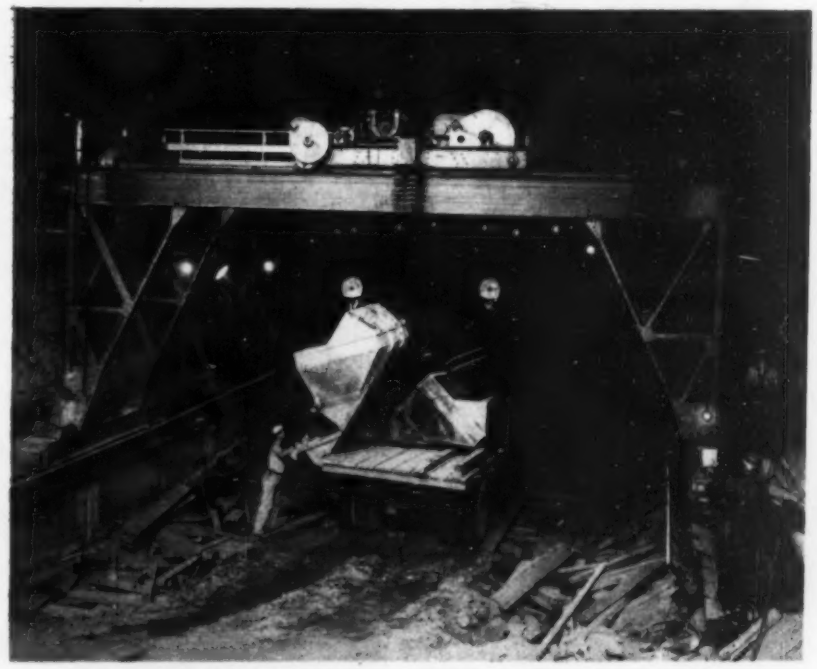
system of chutes at 5-ft. intervals in a vertical direction up the form and at 10-ft. intervals horizontally. These chutes extended through the ¼-in. steel lining plate and were closed as the concrete rose behind the form. The lining plate was supported by structural steel horizontal beams and ribs and was kept in contact with the top edge of the invert concrete by means of hold-down bolts. A system of pull-jacks permitted the rapid adjustment of this form into position of line and grade, after which pressure jacks were run out to hold the assembly in place. The necessary ladders and working platforms were provided for the operation of this equipment.

ARCH FORM DETAILS *(below)*, showing adjustment jacks and wedges, and diagram *(at top)* of plant layout for concreting arch section with pneumatic concrete guns.



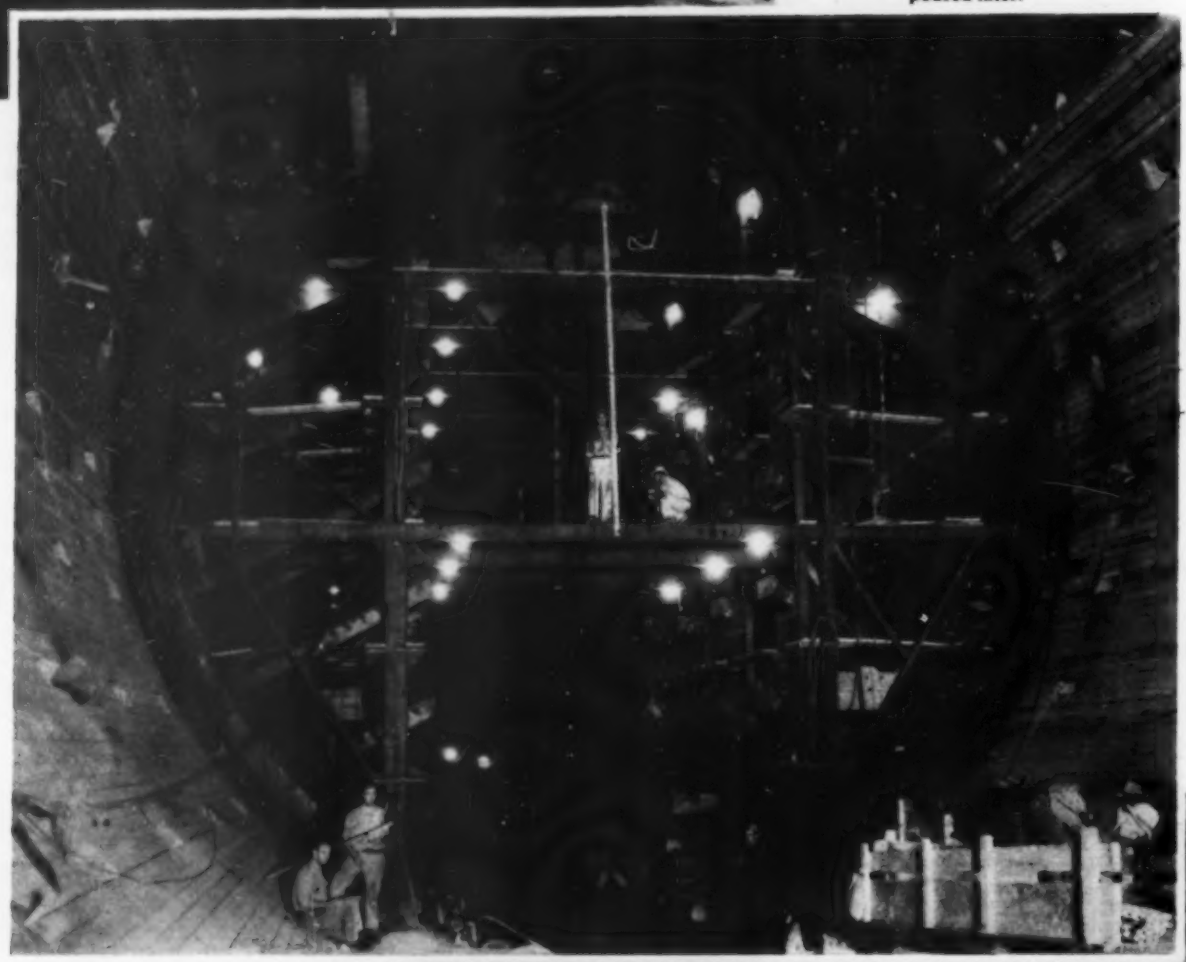
INCLINED CHUTE conveys premixed concrete, delivered by 4-yd. agitator-body trucks, to point of discharge into buckets for placement in tunnel lining.

The same gantry crane and hoists used for the invert were operated on 23-ft. gage tracks along the top of the side-wall form unit. This crane handled the 2-yd. buckets, loaded from the agitator-body trucks, and lifted them to discharge into the chutes on either side beginning at the bottom. Specifications required that men work behind these forms to puddle the concrete into position. About 20 men were required to operate this side-form equipment and a 40-ft. section containing 360 cu.yd. of concrete (net) required from 10 to 15 hr. to place, depending upon the overbreak. The only exception to this process of chuting the side-wall concrete into position was at the top of the section where the head room was insufficient to permit the concrete to flow by gravity. A special type of chute was provided along the top of the form which was hinged at the form end and had a capacity of 2 cu.yd. when lowered into a horizontal position. This combination chute and hopper was filled from the concrete buckets and then lifted about its hinged end



CONCRETE BUCKETS OF 2-yd. capacity are delivered in tunnel by trucks and picked up by gantry hoist for discharge into invert section.

SPECIAL WOOD FORMS, *(left)* containing holes through which concrete is chuted, are used for section where tunnel plug will be poured later.



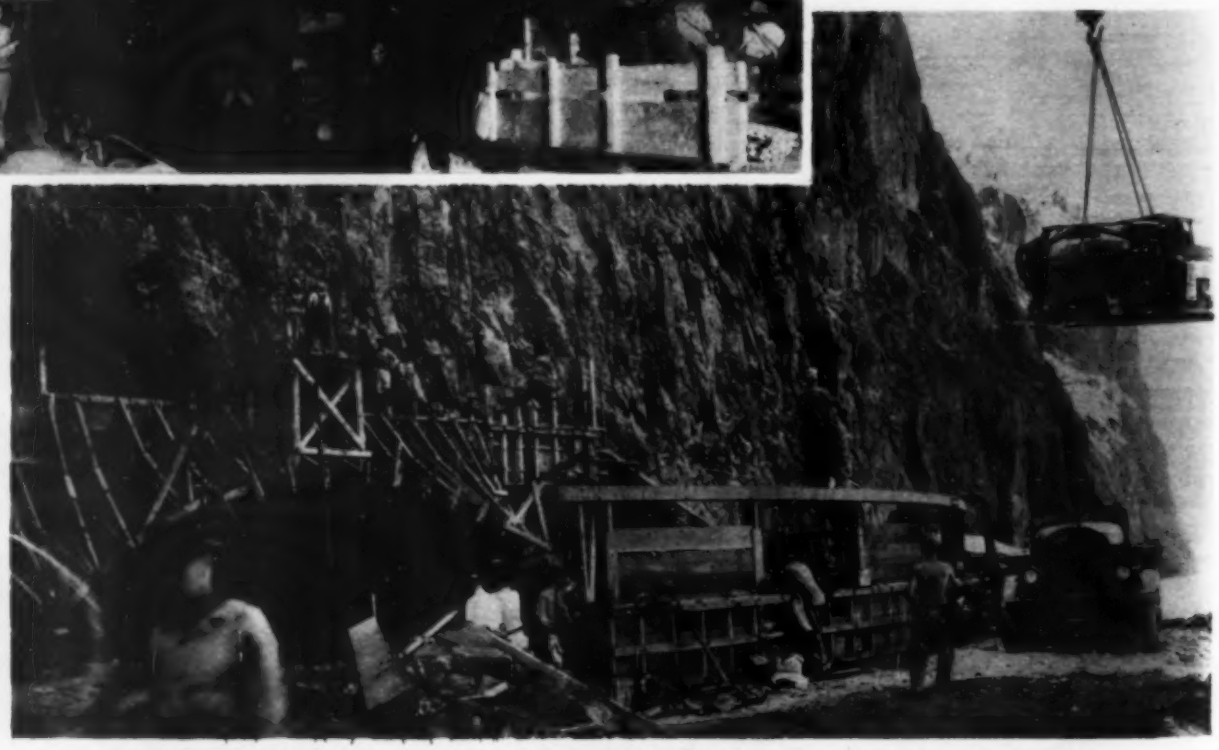
CARRIAGE for side-wall forms travels on rails and is equipped on both sides with inclined chutes for discharging concrete behind forms. This view is at enlarged tunnel section where concrete plug will later be poured.

lowed between the completion of one side-wall pour and the beginning of the next. When the two 40-ft. or the three shorter sections of side wall had been completed, the form was left in position 12 hr. and then moved ahead by air hoists to the next position. The side walls included the section of lining between the invert and an angle 55 deg. from the vertical, and contained 9 cu.yd. of concrete (net) per linear foot of tunnel.

Arch Concreting—The final 110-deg. arch section was placed pneumatically. The arch form was supported on a high structural steel framework which moved on the same rails which carried the side-wall forms. The steel truss supporting members were designed to carry a load of 5-ft. thickness of concrete over the entire arch area, to provide for possible sections of heavy overbreak and, at the same time, to permit uninterrupted trucking operations. Jacks supported the arch form against the top of the side-wall concrete and provided for adjustment.

A special feature of this form was the provision for taking the support off the wheels. Weight of the fresh concrete produced load concentrations higher than advisable for wheels and bearings. Cast-steel pedestals, therefore, were provided to span the rail and bear directly on the concrete shelf. These pedestals and connecting jacks bore directly against the lower beam of the form and were set to take the load while concrete was being placed. During moves they were raised sufficiently to clear the rail. Each jack and pedestal was designed for a load of 92 tons.

The assembly of arch form and placing equipment included the gun carriage and delivery pipe jumbo, in addition to the 80-ft. length of form. The gun carriage was a structural steel frame supported on wheels which carried two 2-yd. concrete guns, air receivers, hoists and travel motors. The guns were located on the lower part of the carriage and discharged into 6-in. pipes which extended up over the supporting jumbo and on to the arch form. Concrete, delivered by trucks, was placed in the guns by lifting the agitator body off the truck and dividing its 4-yd. contents into the two guns. Operation of the concrete guns was in accordance with standard practice,



CONCRETE FOR PORTAL is delivered by crane which picks Rex agitator body off truck and swings it to point of discharge above arch.

by air hoists to deposit the final lift of side-wall concrete.

Temporary timber bulkheads were placed to provide construction joints between pours, with a keyway 1½ in. deep and 10 in. wide. Construction joints in invert, side wall and arch were provided at 40-ft. intervals in those sections of the tunnels to be used only for diversion purposes and this spacing was reduced to 26 ft. 8-in. intervals where the tunnels will be used permanently for spillway discharge. A period of 6 hr. was al-

using the air supply in the tunnel. Although a large air receiver was used with each gun, the nominal air pressure of about 100 lb. often dropped to nearly 50 lb. at the finish of a 2-yd. charge of concrete.

The two 6-in. discharge pipes, at the beginning of each setting of the form, extended into recesses left in the end of the last arch section so that discharge first filled these pockets and then flowed forward and was directed into the lowest corner of the form by means of movable timber baffles. The pipes were gradually withdrawn, by moving the gun carriage back, as concreting progressed, keeping the ends of the discharge pipes in the concrete.

Construction joints in the arch corresponded to those in the side wall and invert, as to spacing. Twelve hours was allowed to elapse between the completion of the last pour of the arch and the removal of the arch form.

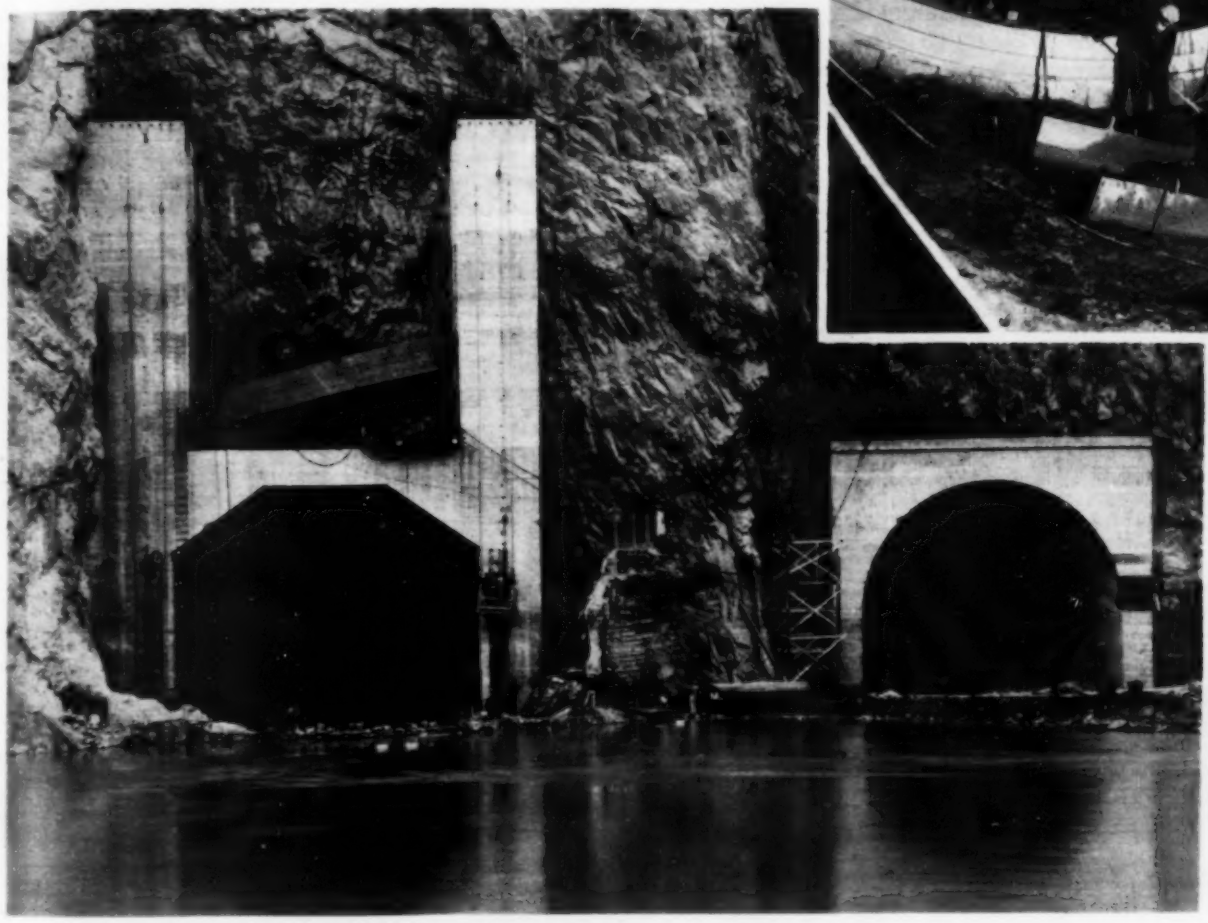
Curves—Operation of the tunnel lining equipment, as described, required certain modifications to negotiate the curves in the tunnels. Both the side-wall and arch forms were constructed in 20-ft. sections and provision was made for the insertion of gores. Sharp angles on the inside of the curves were considered undesirable, so minimum gores of 1 ft. were placed on the inside between each 20-ft. section of tangent form and increased in width to the opposite side. On some of the sharpest curves these gores had a maximum width of 8 ft.

Another special problem in the operation of the forms was the wedge-shaped sections which will be plugged subsequent to diversion operations. Wedge-shaped timber pads were provided on these plugged sections and bolted to the outside of the form. The result provided the required 3 ft. of lining concrete, leaving the inside of the concrete correctly shaped and, in addition, provided the temporary wooden pads to give a smooth face to the tunnel during diversion. Later they will be removed and the concrete for the plugs poured.

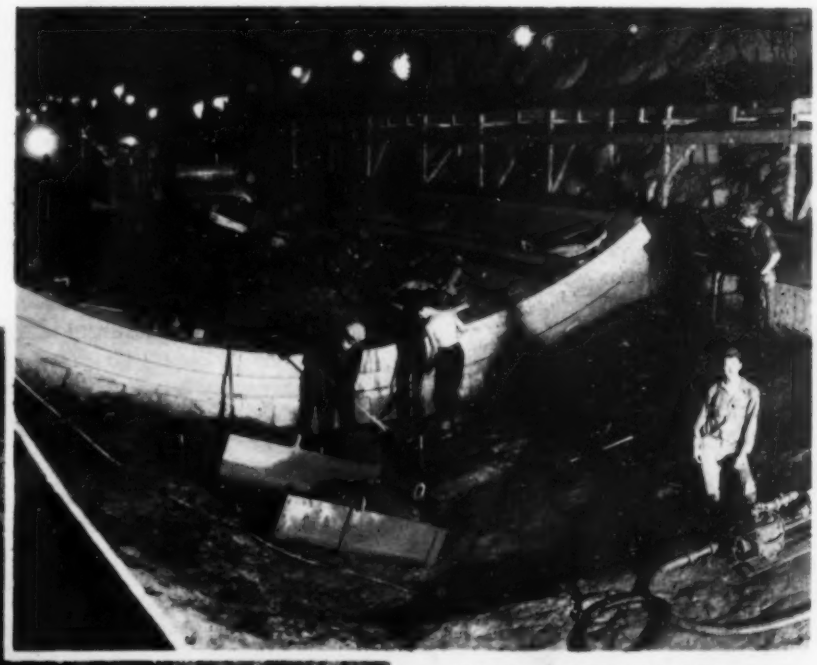
Concrete and Transportation—Lining concrete was proportioned and mixed at the low level plant about 2,000 ft. upstream from the upper portals of the diversion tunnels. Although the volume mixed per shift did not tax the capacity of the four 4-yd. mixers, all of the equipment was in use at various times because of the three classes of concrete required for the lining operations. The mix for the invert and side walls used aggregate sizes up to a 3-in. maximum and the arch concrete had a 1½-in. maximum size. The slump in the various classes of concrete as placed was: Invert, 3½ in.; side walls, 4½ in.; arch, 5 in. The mix for the invert and side-wall concrete was about 1:2.2:4.6 and the cement content averaged 1¼ bbl. per cu.yd.

A serious problem was the arrangement and planning of transportation facilities to keep the lining operations going smoothly. The original plan was to provide three complete sets of lining forms and equipment but subsequently a fourth set was built so that the various phases of lining operations were under way in all four tunnels simultaneously. In addition, it was possible that the three pouring operations might be under way at one time in the same tunnel. In such a case the invert concrete trucks had to pass through the arch and side-wall forms; the side-wall concrete trucks had to pass through the arch form and jumbo. Although the invert roadway provided ample space for a two-lane truck road, the bottlenecks which caused trouble were at the forms. Since different mixes were required for the three sections of lining, it was impossible to divert trucks as needed, and three distinct truck fleets were required for carrying on a complete round of lining operations in a single tunnel. During maximum operation as many as eighteen of the agitator-body trucks were in use.

Specifications called for a two-weeks' spray cure for the lining concrete. The invert section provided no difficulty as the road material kept the concrete moist. Spraying the side walls, however, provided two serious problems. In the first place the water collecting on the invert softened the roadway and made trucking difficult and, during the summer months, the temperature in the tunnels was extremely high and the humidity resulting from the spraying made working conditions severe. As a result the curing process was changed to the use of the Hunt method, using a bituminous coating over the surface of the concrete.



READY TO DIVERT COLORADO RIVER around site of Hoover dam. Upstream portals of concrete-lined diversion tunnels just before blast admitted water to them.



ROCK FLOOR CLEANED preparatory to pouring concrete for lining invert of tunnel. Note thickness of finished section of invert lining behind workers.

Personnel—In addition to the general personnel of the U. S. Bureau of Reclamation and the Six Companies Inc., located in Denver and San Francisco respectively, the personnel in direct charge of the tunnel lining operations was as follows: Bureau of Reclamation, Walker R. Young, construction engineer; Ralph Lowry, field engineer; John C. Page, office engineer; and O. G. Patch, supervisor of concrete production. Six Companies Inc., Charles A. Shea, director of construction; Frank T. Crowe, general manager of construction; A. H. Ayers, chief engineer; Bernard Williams, assistant general superintendent; and J. Perry Yates, office and designing engineer.

The planning and design of the tunnel lining equipment was primarily a contractor's problem and was handled by the engineering office of Six Companies Inc., at Boulder City, Nev., in charge of Mr. Ayers.

Ten Years' Experience With

SAND-ASPHALT ROADS

in North Carolina

SHAPING UP old road surface with tractor-hauled blade grader prior to setting forms for sand-asphalt mix.

TEN years' experience of the North Carolina State Highway Commission in laying more than 1,000 mi. of sand-asphalt surfacing has developed a definite, simplified technique in engineering and in construction methods. This type of surfacing has been used to an increasing extent in the coastal plain section of the eastern part of that state where suitable sands are plentiful and local concrete materials are lacking.

Practically all of the sand-asphalt surfacing laid in North Carolina in recent years according to the present standard specifications and methods has stood up well. Records of the highway commission show that the cost of maintenance is at least no more for the first four or five years than that of concrete paving or asphalt surfacing on a concrete base. It is expected, however, that eventually the sand-asphalt will have to be surface-treated at intervals. Some method of supporting the edges of the pavement also will probably have to be developed when the timber side forms used in construction decay.

SETTING FORMS of 3x6-in. timber along sides of road. Not less than 500 ft. and usually 1 mi. of forms are set in advance.

SCARIFYING old road to permit subgrade to be shaped accurately before applying sand-asphalt surfacing.

TEMPLATE riding on accurately placed side forms is used to check surface elevation of subgrade.

Sub-Grade—One essential requirement for success in sand-asphalt work, the experience of the commission has shown, is a thoroughly drained, uniform subgrade of good carrying capacity. Much of the North Carolina mileage of this type of surfacing has been laid on sandy soils and on old sand-clay roads, both of which provide very good bases. Damp, loamy spots in the subgrade frequently have caused some disintegration of the surface.

Great care is used to obtain a smooth, uniform subgrade surface. When sand-asphalt is to be placed on worn sand-clay roads, the old surface is first well shaped with blade graders as closely as possible to the crown desired. Then, 3x6-in. pine timbers are set along both edges of the sub-base that is to be surfaced.

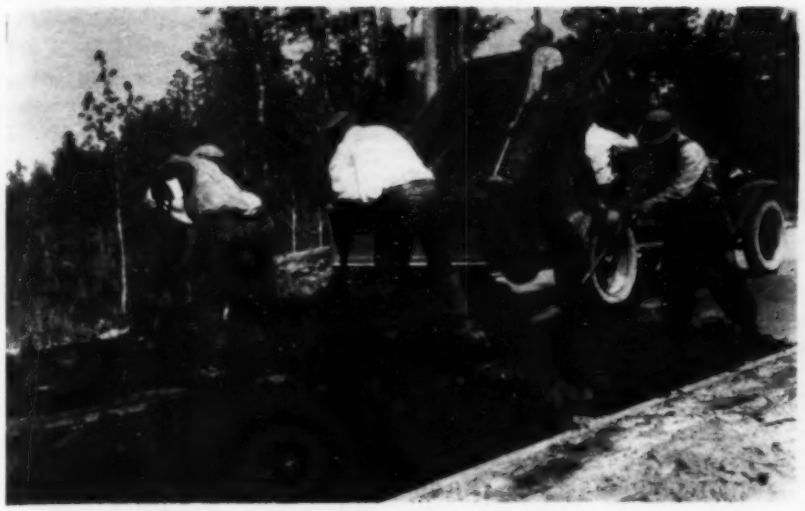
Side Forms—These side forms are accurately placed, since they serve as runways for the strike-off and finishing machine, and the accuracy of their setting largely determines the smoothness of the pavement surface. These forms also must be so securely staked that they will retain their position undisturbed by traffic or by local subgrade failures.

After the forms for a stretch from ½ to 1 mi. are in place, the old road surface between them is well scarified and then shaped up and rolled thoroughly. A hand-operated templet gaged by the side forms is used to disclose any irregularities in the subgrade. Under ordinary conditions it is practical, however, to bring the subgrade to quite an accurate finish with tractor-drawn road machines and gasoline rollers.

Two Courses—The standard practice of the commission is to use two-course work. The base course is 3 in. thick, except where unusual conditions are found. A coarse, graded sand of durable character, entirely free from loam or other foreign material, has been found necessary to get good results.

Sand for the surface course, which in all cases is 2 in. thick, must be of the same quality as that used in the base. The sand should be uniformly graded between the 40 and 200 mesh sieves, with practically none passing the 200 mesh.

Asphalt—A 50-60 penetration asphaltic cement is used. The amount required is varied according to the screen analysis of the sand available. The base course mixture is composed of 7½ to 9 per cent of

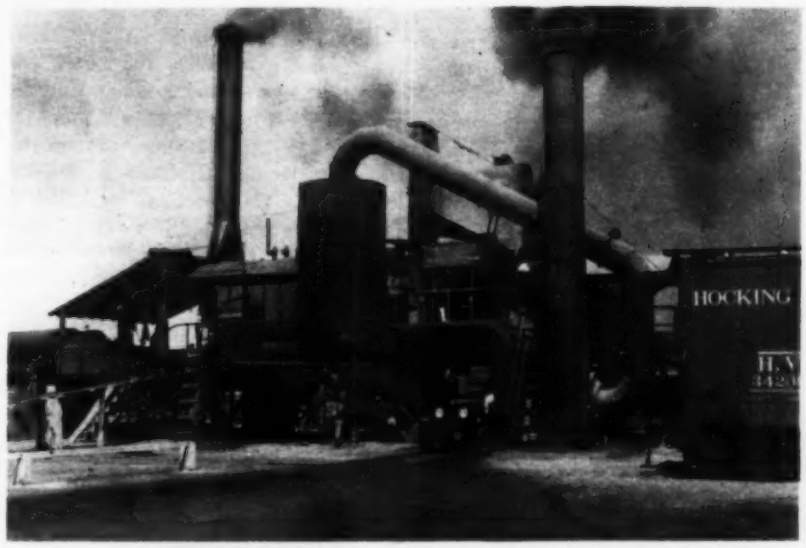


DUMPING loads of mixed material from truck on to steel plate sections directly ahead of the strike-off and finishing machine.

FINISHING MACHINE strikes off hot material previously deposited on steel plate dump boards.

asphaltic cement, and 92½ to 91 per cent sand. For the surface course the proportion of asphaltic cement is somewhat greater, this mix being 10 to 12 per cent. A mineral filler, usually portland cement, also is employed in the surface course, the percentage added being from 7 to 11 per cent by weight, depending on the screen analysis of the sand used.

The accompanying photographs made on a 26-mi. section of sand-asphalt work built by the West Construction Co. of North Carolina, near Kinston, show somewhat typical conditions and methods under which much of the sand-asphalt in the state has been placed. Each contractor modifies the methods to a limited extent but, on the whole, practice has been standardized.



CENTRAL PLANT for preparing and mixing sand-asphalt.

Mixing Plant—On this project a Simplicity mixing plant was set up near a large deposit of acceptable sand close to one end of the job. A power shovel loaded sand from the pit into 1-yd. cars which were drawn up an incline to discharge into elevated bins. From the latter the sand was fed into dryers from which it was delivered to a pug-mill mixer.

By means of automatic weighing devices, checked by frequent analyses of the sand, proper proportions were maintained. The mixture was delivered from the plant to place on the road in trucks. The details of the operation of these trucks were described in *Construction Methods* for January, 1932.

Squeegee Coat—One important feature of the methods of placing the two courses is the application of a squeegee coat of hot asphaltic cement, heated to a temperature above 300 deg. F. This squeegee coat is applied to the surface of the base course before the latter has cooled to atmospheric temperature at the rate of 1/16 to 1/12 gal. per square yard. This squeegee coat is absolutely essential in order to insure a proper bond between the base and surface courses. This comparatively minor feature of construction has almost entirely eliminated difficulties found in earlier work from the surface course creeping on or loosening from the base course so that it became cracked and displaced.

In recent years changes and improvements have been made in the type of plant used in this work, which have resulted in greatly increased progress. In addition, the number of hours that contractors have been allowed to work has enabled them to lay as much as 2,500 ft. of base course and 3,500 ft. of top in one day's operations. No more base course is allowed to be placed in advance of laying the surface course than can be covered by one day's run of the paving plant on surface mixtures, but on the job illustrated by the accompanying pictures, as much as a mile of base was laid ahead of the surface course.

L. R. Ames is the state highway engineer of North Carolina. A. K. Barrus, as president of the West Construction Co., directed the work on the project illustrated by the accompanying pictures.

SPREADING hot squeegee coat on base course while latter is still warm. This operation prevents creeping of surface.

TEN-TON ROLLERS compact both base and surface courses. All rolling is done longitudinally, from sides toward center line.

Helps to Successful Contracting

Seventh of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

By HARRY O. LOCHER

Contractor, New York

VII—Equipment

WITH right prices, a good organization and well chosen, properly installed equipment, it would be pretty much out of the question to think of a job ending disappointingly.

What is well chosen equipment? Usually, standard equipment. We mean by this, equipment that is not special, "tailor-made." Of course, tailor-made equipment is sometimes unavoidable, for nothing standard can fill its place. In such cases the cost of this equipment should be absorbed by the job it was designed to fit.

Too often, however, contractors buy expensive special equipment for certain portions of their work and later, to their disappointment, find that standard plant would have done the work as cheaply, and would have been readily usable or saleable at the completion of the job. Generally, there is never a second opportunity to use special plant, and rarely can it be sold, except at a tremendous loss. Bearing this fact in mind, it is often economical, in the end, to do work with standard equipment, even at some additional cost, rather than to aim at small or doubtful savings through the use of special equipment. For contractors who do special or out of the ordinary work, of course, "special" equipment becomes "standard" equipment.

Purchasing Equipment

THE purchase of equipment should be most carefully and thoughtfully done. You are dealing with the "works" of your job. Some equipment manufacturers and their product are so well proved and known that there is not the slightest risk in purchasing from them. The main consideration in such cases is whether what they have to offer fits the job in hand. Some equipment salesmen are frequently over-zealous in their attempts to point out just how well their product will fit the job. In most cases they are getting out of their field, and it has happened more than once that in so doing their advice has proved costly to contractors. Not many equipment salesmen have experience to advise contractors how to plant their jobs. By being tactful they often can be helpful and further the consideration of their product, but they should be careful with their plant advice. If they go too far it often acts as a boomerang and counts against them later.

On a job not yet completed a time-honored machinery manufacturer designed certain equipment for a contractor and made recommendations as to what could be expected in progress and costs. The machine worked ideally and made some great records and had it been held in bounds its installation would have been justified over and over again. But they sought ever higher records and in so doing isolated this portion of the work, so as to make of it a separate job. Coordination and sequence, making for economy, were disrupted, and, as always, the contractor had to foot the unexpected bill. The machine design was splendid, but the way it was used is another story.

Mechanical Inspection

IN purchasing equipment that is not well known, but that seems unusually suitable for the work,—and such new equipment is coming out all the time—it is but common sense to have a competent mechanical man inspect it thoroughly "inside." A nice cab or housing, or a slick coat of paint, especially on a used machine, are all right, but they wont prevent trouble when things go wrong out on the job—it's the "works" of the equipment that count. So the "works" are what you should be concerned in.

Often a man is sent to inspect a used machine who knows little or nothing about machinery. Looking wise, he walks around the machine, gingerly climbs aboard, sagely points out that this gear or that pinion is pretty badly worn, that the brake linings are all "shot," or that the boiler grates are about gone. He takes the word of the seller about the real condition of the boiler, the flues, sheets, cylinders, steam chests, rams, frictions and all the rest of the mechanism. Then he comes in and makes his report. Now, if he is dealing with an absolutely dependable seller he may be on fairly safe ground, but it's mighty hard for a man with a machine to sell to stick to the facts 100 per cent. His inclinations may be all right, but he is usually just a little biased in his own favor. Of course, if the machine is bought "as is," there can be no comeback. Then, the inspection should be more rigid than ever.

Inspecting machinery is no superficial job for a dressed-up, partly competent, non-mechanical man. It's a precise job for a competent, dependable mechanic, in overalls and with tools. Such a man, like the one we described in a former chapter, who had a machine pulled down and spread all over the floor, will take off the cylinder heads and the steam chest covers. He'll inspect the rams and the frictions, the breaks, the crawler and all other mechanism. He'll note the practical condition of the gears and pinions—they don't have to appear new to have a lot of service left in them. He'll fire up the boiler, or test it under cold water pressure. When he gets through his report will mean something as a guide for spending your money.

"As to prices, buying equipment is about like purchasing anything else—you can expect to get just about the value you pay for. Proved, dependable equipment is not usually found on the bargain counter."

A big 4-yd. steam dragline began noticeably to lag; the coal and water consumption seemed excessive. The machine was shut down, and a competent operator and a mechanic began to search for the trouble. When the cylinder heads came off it was found that the cylinders were badly scored. A look inside the steam chests showed that the valves and valve seats were in miserable condition—all the results of neglected lubrication. A trip to a machine shop, where cylinders were rebored and valves reseated, made of this dragline almost a new machine. She became alive, power was greatly increased and the coal and water consumption were unbelievably decreased. The water, incidentally, was being paid for by the 1,000 gal. and was hauled 27 mi. in rented tank cars at regular freight rates. The savings during the remainder of the job were tremendous because two competent mechanical men knew their stuff.

If the equipment is gas, oil or electric, a man competent in this type of machinery should go through with an inspection equivalent to the steam man's. Of course, all this isn't necessary with new equipment. But in the case of new equipment that is not well known, unless you are familiar with its performance through the experience of others, you are not spending your money wisely or safely unless you have an inspection made by a man fully competent to make it.

Standardization

A CONSTRUCTION job is an expensive proving ground for new and untried equipment, and the contractor usually has to shoulder most of the expense and all the annoyance, trouble and delay. You will recall the job we mentioned a few months ago, on which an assortment of different makes of shovels was used. Another contractor started out with a certain shovel; it suited him and as he grew he stuck to this make of shovel. Finally he owned a great many of them and no persuasion could ever make him switch, not because he didn't think there were other shovels equally as good—he knew there were—but simply for the reason that he realized that standardization meant economy in keeping on hand a lesser amount of parts, and in switching these parts from one job to another, or parts from an idle shovel to a busy one. His operators, too, were thoroughly familiar with all the shovels and could be transferred from one machine to another.

It is common sense to assume that there is everything to gain and practically nothing to lose in standardizing, in so far as it is practicable, on as much of your equipment as possible.

Prices

AS to prices, buying equipment is about like purchasing anything else—you can expect to get just about the value you pay for. Remember that the "works" of a construction job is well proved, dependable equipment, and that is not usually found on the bargain counter. Quality costs more to start with, but is cheaper to finish with, and at the finish is where a lot of contractors can use the money.

In another chapter we touched on the vital necessity, if a contractor is to keep afloat during these days of close competition, of keeping posted on new equipment as it comes out, and of determining whether or not such new equipment in the hands of competitors will have him beaten before he starts, or whether what he has is still up-to-date enough to keep him in the running a while longer. If a new model machine will handle enough more work at less cost than your old one, it's time to change, or your competitors who do change will know they have little to fear from you when you take out plans. They

know "it won't be long now." When the cost of keeping up an old machine, plus the additional cost of actually doing the work, due usually to decreased volume, runs your unit costs away beyond those obtainable with a new machine, it's time to change.

It is amazing, sometimes, the amount of money it requires to keep an old shovel or dragline plugging along, even with only a part of the volume a machine of its capacity should turn out. Too few contractors divide this big upkeep cost by the yardage and see in black and white what it comes to "per yard."

A 1-yd. gasoline dragline, built in 1925, was laid up in May, 1932, on account of excessive upkeep costs, and its work, in a quarry, was done cheaper by hand loading. There comes a time when you cannot possibly afford to continue running an old piece of equipment. This is not to say, of course, that all used equipment is uneconomical; far from it. There are years of economical service in some types of equipment, notably compressors, hoists, and road rollers. But when you consider shovels, draglines, mixers, drills, pumps, trucks and other types of equipment which have to stand the gaff, there comes a time when no up-to-date, wide awake contractor can longer afford to operate them. Of course, some equipment of not too ancient vintage, with careful attention, can be kept going and doing cheap work for a long time and prove a worthy competitor of its more modern brother. But the time comes when it's "done," regardless of how well it might have been kept up. In some instances this time may come over night, when the introduction of a spanking new model, embodying improvements for increasing volume and decreasing costs, makes further competition from the old machine hopeless and out of all question.

Obsolescence

WE are talking, of course, with contract work as our background, where competition is intense, where equipment is hitting the ball day and night, and where every yard, every dollar—and every shutdown—counts and costs. In some small or medium-size sand and gravel pit, where a few truck-loads or a car or so goes out each day, or maybe each week, anything that will roll over might serve about as well as something that came out of a factory only yesterday—but not on a close price contract job. Here a machine has got to deliver the goods, a lot of 'em and at low down costs.

Too often contractors are led to use old, obsolete or semi-obsolete equipment for the sole reason that they have it on hand, thinking they have an advantage over contractors who might have to buy new equipment for the work. The very fact that a competitor has to buy new and up-to-the-minute equipment, with no upkeep costs at all for a considerable period and with a greater output at less cost, shifts the advantage to him rather than to the owner of the equipment of yesteryear.

Depreciation and obsolescence are often economic rather than physical. Even a splendidly kept up old machine cannot compete with a more modern one which can deliver more work at less cost. You must keep step with the advance of equipment, or you will be ordered out of line. Just a few short years ago truck bodies here in New York held 3 to 4 yd.; now they hold 8 to 10 yd. Transit mixers carry a 5-yd. proportioned batch or 5 yd. of mixed concrete, superseding the ubiquitous stock piles of sand and gravel and cement, mixing plants, pipe lines, pumps and whatnot. Drill carriages supporting from 5 to 30 drills hammer away relentlessly at tunnel faces, replacing the old columns, quarry bars and tripods with their individual crews and operation. Semi-revolving and completely revolving tunnel shovels handle more muck at less cost than was possible by hand work in bygone days. Two men with a mechanical drill sharpener turn out a quantity of splendidly sharpened and tempered steel that would fairly bewilder the old time blacksmiths. Drill trucks mounting from 4 to 10 drills, with amazing records to their credit, supersede tripod drills and jackhammers individually operated. Mechanical loaders place as much sand or stone in trucks as 20 to 30 men formerly did.

"It is economical, in the end, to do work with standard equipment, even at some additional cost, rather than to aim at doubtful savings through the use of special equipment."

The contrasts could be carried on and on to illustrate the advance or evolution of construction equipment. It's like the rule of the jungle: Keep fit—posted on new equipment and new methods—or you perish. The pace is ever getting faster—you have to keep up or drop out.

Maintaining Equipment

EVERY good construction man knows the importance of maintaining his equipment and keeping it in first class operating condition. With a good superintendent and master mechanic on the job, a contractor need have no fear that his equipment is not being kept up. Always, it seems, we come back to the fundamental requirement of good, earnest, dependable, capable men. Maintenance is something like purchasing: if earnest, dependable, competent men are in charge, that's all there is to it.

We could go into minute detail as to how to buy and how to keep equipment, and how to do about everything else on a contract job. The writer feels, however, that these articles are being read mostly by construction men who know their stuff, have their own methods and are interested in their particular phase of the work. The chief aim of these articles is to place before them the contract job as a whole, and to bring about a more sympathetic understanding of each other's problems and difficulties, and a broader, more helpful cooperation. We must realize, too, that the "old man" is generally all right, that his is not a bed of roses, and that his shoulders most always carry the heaviest load. Let him know that he can bank on us.

Guess I sort of jumped the track right here, boys. My thoughts drifted back to an "old man" who has gone on. He understood us fellows so well and did so much for so many. What a loyal, hard-hitting following was his, and what a pride he took in them! Well, all of us have such memories now and then. Let's get back to the subject.

Depreciation

DETERIORATION and depreciation can be materially retarded if the proper care is given to equipment during the time it is idle or laid up for the winter. If possible, storage should be made under cover; at least, all mechanism should be protected from the weather by housing of some sort, or tar paper or canvas covers. On electrically-driven machinery motors and generators should be most carefully stored to keep out out weather and moisture. Boilers should be thoroughly washed.

Some boiler men consider it good practice to use oil in the last wash water to prevent inside corrosion during the lay-up period. Flues should be thoroughly cleaned. Fireboxes, ashpits and smokeboxes should be particularly well cleaned. The flue sheet in the smoke-box end of the boiler of a standard-gage locomotive on one job went through along the bottom, due, it was concluded, to the chemical action of water and moisture on the always neglected small quantity of soot and ashes at this point. After a thorough cleaning and washing a boiler should be painted. The fittings, gages and so forth should be removed and boxed. The boiler is then properly prepared for the lay-up, and will be worth as much in the spring and as ready for service as when you placed it in the yard. Otherwise, it will cost you some real money in deterioration, and will be in fine shape to get you in trouble right off the bat when you put it into service in the spring.

On steam equipment, cylinder and ram heads should be removed, also steam chest covers, and the inside thoroughly oiled or greased along with the pistons and follower heads. The covers then can be replaced loosely. New gaskets all around will more than likely save a lot of trouble in the spring, along with new gland and stuffing-box packing. All burnished parts, such as crossheads (which should be loosened and greased inside, along with the wrist pins) pistons, levers, crank pins, everything that will rust or corrode, should be cleaned and greased. Old hardened grease should be scraped from gears and pinions and new grease or heavy oil put on. The competent gas and oil man knows what is necessary to do, and does it, so that this type of equipment may go safely through the lay-up period.

Concrete mixers should be thoroughly cleaned and greased. It is unbelievable the conditions some mixers are in when they are stored away for winter, or at the end of a job. The way they are neglected would lead one to believe they weren't worth a dollar, instead of from hundreds to thousands of dollars.

Small equipment, materials and tools should be carefully gathered up and put safely and systematically away. One superintendent used to send a few men and a truck over a job every two weeks, combing everywhere for tools just lying around. They always made a good haul, and it checked carefulness.

"You must keep step with the advance of equipment or you will be ordered out of line."

If you want to get a line on how good some superintendent or mechanical man is, visit his yard, preferably in midwinter and see how the equipment is laid up. If the boilers still have ashes on the grates and in the ashpits, if the smoke box and flues are not cleaned, if the stack opening is wide open to weather, if the boiler is not washed, and if the other equipment shows signs of neglect, you can conclude that here is a pretty loose outfit all around; and that slipshod neglect is costing real money.

Renting Equipment

WE DISCUSSED in the article on "Equipment and Methods" (*Construction Methods*, January, 1933), the renting of equipment. It might be well to bring out here that, due to the cessation in construction work during the last three years, there is a tremendous quantity of

used and slightly used equipment available for the large amount of construction work which is bound to be started soon. It can be rented or purchased. If the owners of this equipment would go over it and place it in first class condition, having in mind what it would mean to them in using it themselves, or how it would enhance the possibility of its sale or rental, equipment which now seems a white elephant on their hands might very soon prove to be a valuable asset. There perhaps was never a time when it could be repaired and put in all around good condition as cheaply as now—and it would employ many a man who sorely needs work.

On a big construction job finished a number of years ago, on which nearly $2,000,000 worth of equipment was used and which was immediately offered for sale upon completion of the work, they didn't get to first base on the selling until a crew of mechanics and helpers under highly competent direction had gone over the entire plant and put it in first class condition. When this fact was widely advertised and became generally known, the equipment was quickly disposed of at most gratifying prices.

But don't think that spreading a coat of black paint over a machine is repairing it. Get at the works. Renew worn parts, and really put the equipment in condition to "hit the ball."

Hand Labor

WITH this tremendous amount of equipment available at such advantageous terms it is, indeed, unfortunate that the proposal of doing work by hand, as a means of employing more men, should have become so widespread. Such a conclusion is illogical and fallacious. It can be admitted that in some cases hand work can be dragged along to lengthen employment, and at not much greater cost. It can be further admitted that certain work can naturally be done more cheaply by hand, as, for instance, hand loading in quarries or sand pits by the task method or straight day labor, and in other places where big volume in short time is not so much a factor. The thoughtful use of equipment, especially at present-day prices, can be counted upon to bring about more economical use of the construction dollar, the taxpayer's money, which means more work, and often better work, for the same or a less amount of money. Spreading the dollars further will, in turn, spread and lengthen employment, and construction methods will continue to evolve and advance, rather than retrogress.

NEXT MONTH—The eighth installment of Mr. Locher's series on successful contracting will discuss "Subcontractors."

RECONSTRUCTED HIGHWAY widened with concrete shoulders and resurfaced with brick utilizes old narrow pavement as base for new structure. Mortar bed of varying thickness on old pavement corrects variations in grade and provides smooth riding surface.

Old Highway Surfaces in Illinois

REPAVED WITH BRICK

SALVAGING of old concrete pavements while they still had value as base courses was the principal object of the Illinois Division of Highways when, in 1931, it undertook to resurface more than 60 mi. of existing slab which had been built prior to the development of design standards adequate for present traffic needs. Because of its availability throughout the state, its adaptability as a surface for existing concrete base and its record of low maintenance on Illinois roads, paving brick was selected for the wearing course of the rebuilt pavement. Satisfactory results obtained on the 1931 mileage and on an equal mileage resurfaced in 1932 indicate a probable continuation of the program in succeeding years.

Need for Resurfacing—Illinois concrete roads constructed before 1921 were designed in general 15 to

WEARING COURSE of 2½-in. brick is laid between concrete curbs on ¾- to 1¼-in. sand-mastic cushion.

DOUBLE SCREED riding on steel angles on concrete curbs and pulled forward by paving mixer (used to prepare sand-mastic mixture) strikes off cushion to true crown. Forward screed strikes off slightly above desired grade, roller between screeds compacts cushion, and second strike-off spreads thin layer of mastic to final grade.

18 ft. wide and with either a 6-8-6-in. cross-section or a uniform 7-in. thickness. The concrete was proportioned, mixed, placed and cured by methods which conformed with accepted practice of the day, but the pavement strengths were not equal to those developed in more recent years. Although adequate for traffic at the time, these old pavements within the last few years, especially on heavily traveled routes, have shown a large number of corner and center breaks, and the resulting maintenance has been excessive. By 1931, it was necessary to begin salvaging the old concrete by some kind of resurfacing.

Design of Concrete Shoulder—After deciding upon brick as the resurfacing material, the Division of Highways began the development of a design involving three features: (1) Strength to carry present day traffic; (2) widening to 20 ft., and (3) maximum utilization of the old concrete pavement as a base. The most important element of the problem was the design of a shoulder which would both take care of widening and reinforce the weak edge of the old slab.

As finally worked out, the design required undercutting of the old pavement for a distance of 12 in. and placing of concrete under the slab to a depth of 6 in. Width of the concrete shoulder was sufficient to give the resurfaced highway a width of 20 ft. In the 1931 design, the entire widening strip was carried to the height of the brick surface, about 4 in. above the old pavement, and was extended over the top of the old slab a distance of 6 in. In 1932 the engineers modified the design by reducing the width of the header curb to 12 in. and by making the depth $3\frac{1}{4}$ in., of which $2\frac{1}{2}$ in. is for the brick and $\frac{3}{4}$ in. for the cushion. Concrete is placed under the old slab to a depth of 6 in. as before, but the bottom of the concrete shoulder is sloped upward from a point 3 in. outside the edge of the old pavement at an angle which reduces the total thickness of the shoulder to 9 in. at its outer edge.

Patching Concrete Base—On all resurfacing projects, portions of the old concrete slab which have reached a state of practical failure and can not be depended upon as a satisfactory base are removed and replaced with fresh concrete of the same thickness. This procedure applies to old bituminous patches and existing corner and center breaks. Cracks are cleaned out and filled with bituminous material or concrete, and the few dangerous cracks are torn out for their full length and replaced with concrete patches.

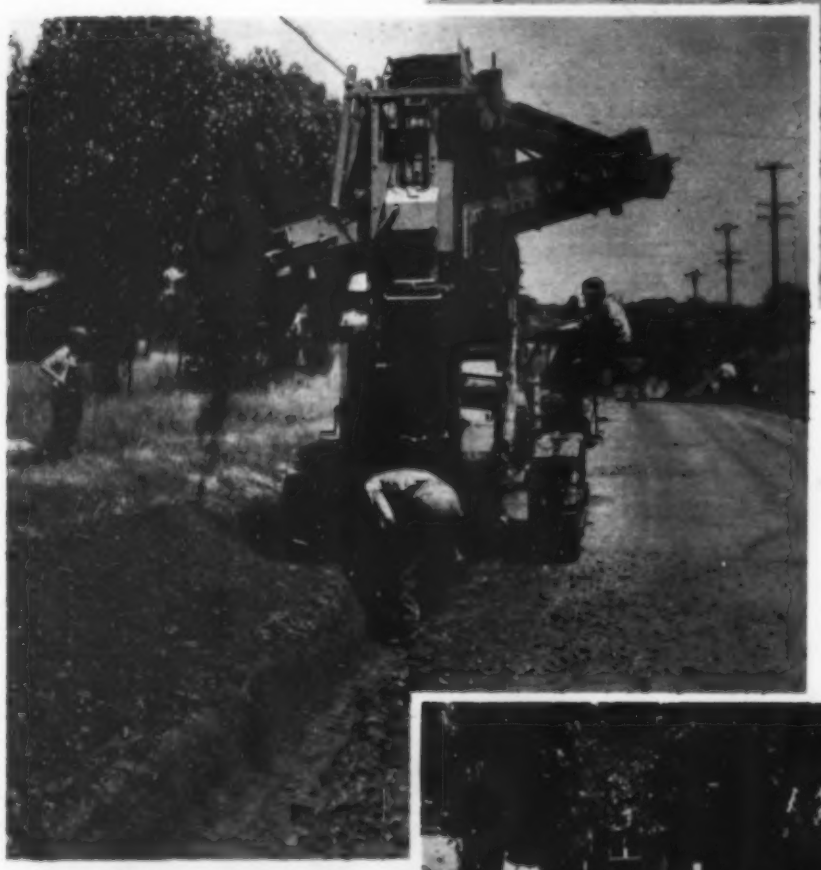
Correcting Grades—At first it was thought that surface inequalities in the old slab could be taken care of by the sand-mastic cushion, but this idea was soon abandoned in favor

SQUEEGEE POTS *(below)* distribute hot asphalt joint filler on new brick surface, filling joints to bottom and leaving thin film on top of brick

ASPHALT KETTLE moved forward on sanded portion of brick pavement heats joint filler for squeegee pots.

of a 1- to 3-in. mortar bed to be floated over the old pavement surface where variations between the old and new grade exceed ¾ in. In many cases this mortar bed serves to provide superelevation at curves and to correct dips and bumps to a depth of several inches. Where unsatisfactory grades or poor alignment exist, the old pavement is torn out and replaced with standard brick construction.

Construction Procedure—Resident engineers on resurfacing projects establish new alignment and grades for the concrete curbs well in advance of construction operations. The first step in construction is excavation for the curbs. This operation has been handled in a number of cases by novel methods, one of which is illustrated by the photograph of the trenching machine.



TRENCH for concrete curb along edge of old pavement is excavated by Barber-Greene ditcher.

STEEL FORMS for concrete widening curb are securely braced. Because of difficulty of spading concrete into space under edges of old pavement, slump of 3 to 4 in. is required in concreting narrow curbs.

After installing forms for curb widening, the contractors usually place concrete in both curbs simultaneously, operating a paving mixer on the old slab. On practically every project, it has been found advantageous to close the road to traffic to permit this practice. In general, replacement of defective pavement is carried on simultaneously with concreting of the curbs, although several contractors have preferred to do this work a mile or two in advance. Beams are taken on each day's run, and as soon as these beams show satisfactory strength, operations are allowed to proceed. Because of possible damage resulting from vibration, no traffic is permitted on the pavement during the curing period. This restriction interrupts the hauling of brick.

TO REINFORCE EDGE of old slab, excavation for concrete curb is carried under slab 12 in. toward center line and to depth of 6 in.

As soon as the concrete beams show the required strength, the contractor begins placing the mortar bed. The areas to be covered and the thickness of the bed are determined easily by riding a templet on the curbs. All points on the old pavement surface measuring more than 4 in. (2½ in. for brick and 1¼ in. for mastic cushion) below curb grade are marked for covering. A mix of 1:3 mortar is placed either directly by a paver or by trucks hauling from a central plant. After curing overnight or for 24 hr., the contractor is permitted to haul mastic cushion and filler sand, but not brick, over the mortar bed.

Mastic cushion containing 6 to 8 per cent bitumen is mixed by a paver traveling on the mortar bed or by a central plant. Asphalt plants are most satisfactory for drying the filler sand, but many contractors spread the sand on the pavement well in advance of the work and turn it with a blade grader while it is being dried by sun and wind. The latter method requires keeping a reserve of dry sand in storage to avoid construction delays in wet weather. A double strike-off, of the type illustrated by one of the photographs, is the standard tool for spreading the sand-mastic cushion.

Laying of the 2½-in. brick course and filling of joints follow standard practice. Sanding of the surface and rolling of the sand proceed closely behind the joint filling; otherwise, in cold weather, the sand does not become embedded firmly in the asphalt, and a slippery surface results.

JOB ODDITIES

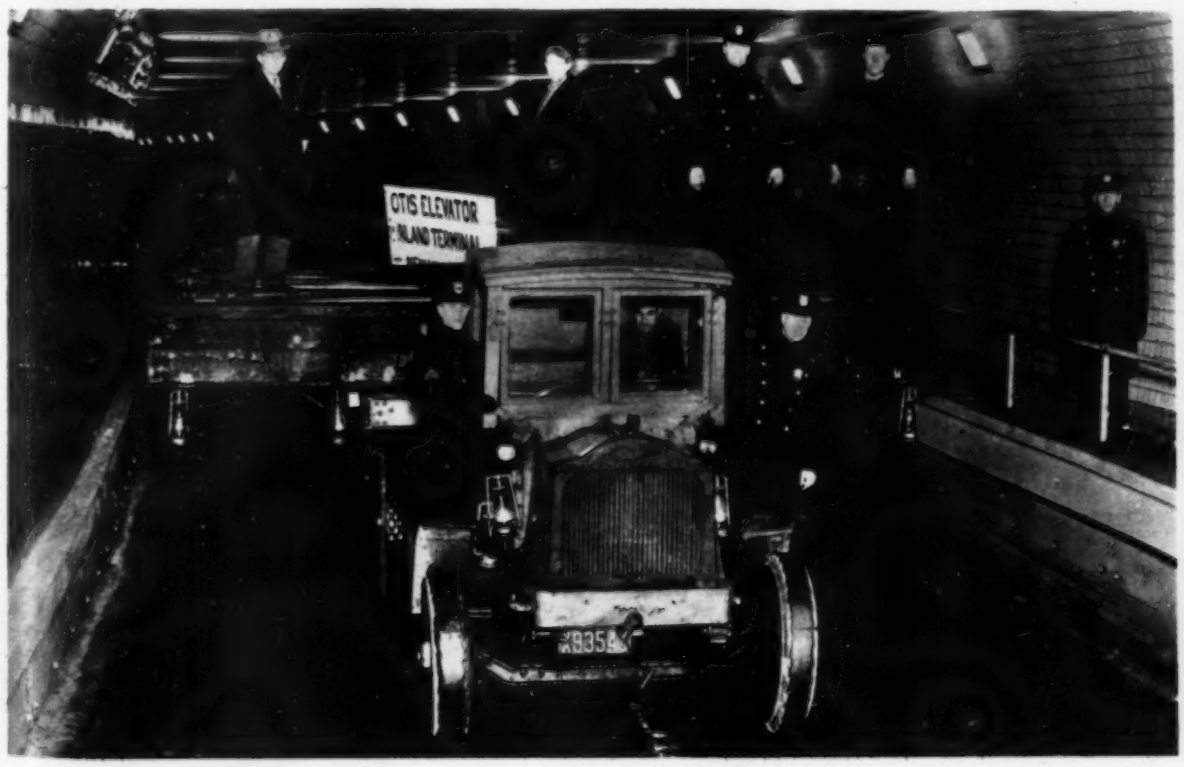
PERILOUS PERCH (*below*) for drillers scaling down precipitous walls of Colorado River canyon at site of Hoover dam. Safety lines hold workers and "hard-boiled" hats protect their heads from falling rock.

Wide World

Wide World

BIGGEST TIRE. Goodyear product, which has been touring country, is 12 ft. high and 4 ft. wide. With yoke connection to automobile, it weighs 3,900 lb., and is valued at $5,000.

A TUNNELFULL. (*Below*) Platform for world's largest commercial elevator completely fills Holland tunnel under Hudson River during trip from Otis Elevator Co.'s plant at Harrison, N. J., to Inland Terminal Building in New York. Platform, with width of 17 ft., length, 34 ft., and weight, 10 tons, will handle fully loaded trucks.



ALUMINUM SPIRE of octagonal French Gothic design tops German Evangelical Protestant Church at Pittsburgh. Henry Hornbostel, architect.

Appraisal Made of Southern California's
EARTHQUAKE DAMAGE

By J. I. BALLARD

Pacific Coast Editor, Construction Methods

AT a price of 120 lives and $50,000,000 of property damage the southern California earthquake of March 10 redemonstrated a well recognized construction principle that buildings designed only for vertical loads have little or no resistance to lateral forces. No outstanding new facts were learned concerning earthquakes and their effect. Defects in construction and deficiencies in design to resist earth quake forces, were reemphasized. In the area reaching from Long Beach to Los Angeles, a distance of about 15 mi. no structural frame building was damaged seriously. Principal damage was confined to the class of buildings between those with a structural frame and residences, including the one- to four-story brick-wall type of building that proved particularly weak against earthquake stresses.

ENTIRE FRONT of Securities National Bank building, in Compton, is shaken out, as are fronts of stores in background.

The following observations are based on a four days' inspection of the stricken area, beginning the second day after the shock.

On the morning of March 12 the city of Long Beach had the emergency work of caring for the injured and homeless well in hand. Relief agencies were feeding thousands in parks. People were not allowed to return to their homes nor were any buildings allowed to be reoccupied until they had been inspected and found safe for occupancy. The work of clearing up debris on the streets was getting started and within a day or two the main streets presented a normal appearance.

The most striking observation of the damage was the extent of failures of brick parapets or fire walls of which dozens on one- to four-story buildings had been shaken off and were littering the sidewalks and the streets for many blocks. This type of damage also included the usual architectural treatments and cornice work of stone. Obviously, this damage had been particularly dangerous to pedestrians and those who rushed out of buildings when the first shocks were felt. In fact, inquiry revealed that the deaths and a large portion of the injuries were caused by falling debris. Not a single fatality had resulted from the original collapse of a building.

Causes behind this type of damage are several. Probably the main one is the inherent lack of lateral strength of brickwork, particularly along the top of a wall where joists or rafters provide no adequate tie. This condition is shown repeatedly in the accompanying pictures. In most cases the usual type of joist tie was installed but proved ineffective and did not have much apparent advantage over the cases where ties were not used.

Another factor was the generally poor grade of brick work and weak mortar which was strikingly deficient

PARTIAL DAMAGE, showing hollow tile filler wall dislodged from structural steel framework.

TYPICAL BRICK WALL displacement, with automobiles in streets buried by shower of debris.

CLEARING UP DEBRIS from typical brick wall failure, caused by lack of lateral strength. This type of structure suffered greatest damage.

monolithic concrete buildings had an excellent record. Some of them did not reveal any apparent injury and those that showed cracks were not damaged seriously. The strength of this type of building against earthquake shock was notable and was observed not only by those acquainted with construction but also by the general public. Most of these buildings are new and are built along simple architectural lines, without the overhanging ornamentation common to the older type of building.

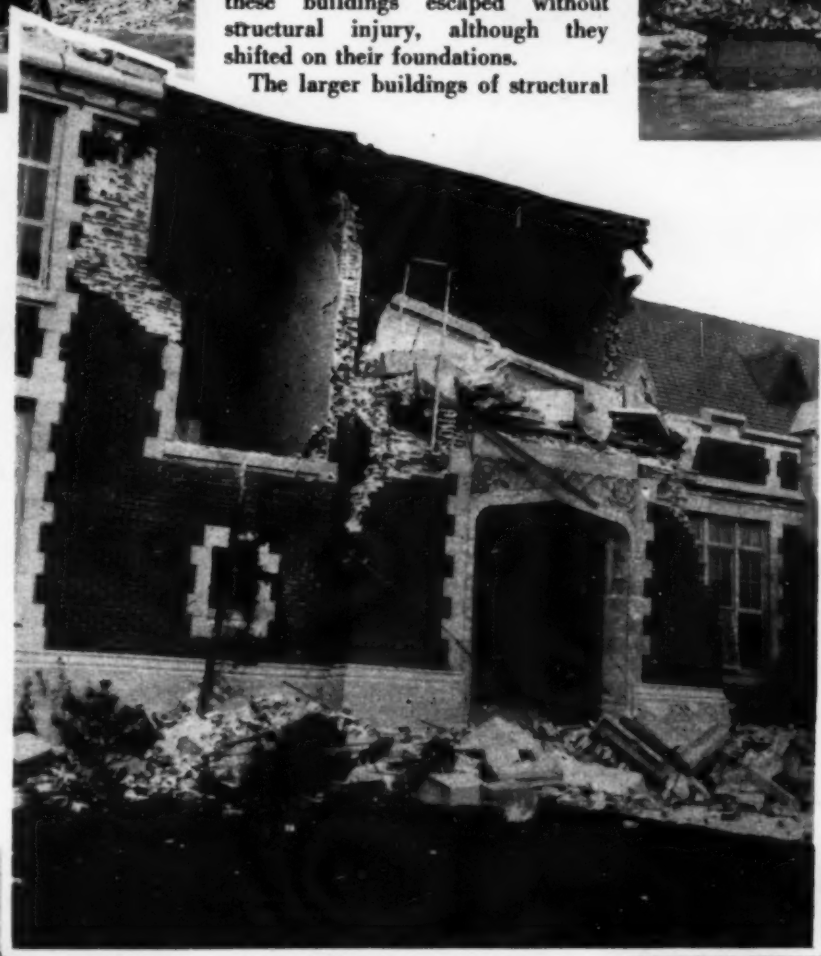
Timber frame—stucco types of small apartments showed a good record of resistance to damage. Often these buildings escaped without structural injury, although they shifted on their foundations.

The larger buildings of structural

REAR WALL of building shaken out, leaving rafters and roof joists unsupported. Another case of deficient lateral strength.

in cementing power. New restrictions that are now being planned, which will greatly increase the amount of Portland cement required to be used in mortar, will go far in reducing this weakness. Again, the unsupported fire walls, above the roofs, often weakened by the insertion of metal flashing to make a water-tight joint, did not have the rigidity or strength necessary to resist the lateral stresses. Brickwork resting on steel lintels over windows and doors in both old and new structures was particularly weak in resisting shock. By way of contrast, many properly constructed brick buildings sustained little or no damage.

The smaller number of modern



ORNAMENTAL FEATURES of school building architecture constituted a menace as they fell, after being loosened from their supports.

A COMPARISON of the stability of a building corner, with its natural bracing, and an unsupported section of wall that dropped to the street. Joist ties apparently ineffective.

frame construction, although suffering superficial damage to partition walls, outside facing and interior plaster, were not injured as to essenital elements. After inspection, all of these buildings were reopened and repairs did not interfere with their use. This type of building includes both steel and reinforced concrete frames and filler walls of concrete, brick and tile. The earthquake was not severe enough to provide much evidence as to the relative merits of these various features of construction. Further, the indications did not permit any generalization on the advantage of rigid frames over those of more flexible construction.

In some cases tile filler walls were racked and shattered to the point of falling out. Brick filler walls had not been stressed sufficiently to indicate the characteristic X cracks through the panels, although there was evidence of slight movement along the edges of columns and the under sides of beams. Concrete walls in this type of building, in general, showed no serious damage although some cracking was apparent. One advantage of the reinforced concrete wall is its ability to remain in place even if badly shattered. This is not true of the brick or tile filler wall, and an improvement in construction would be the provision of dowels or ties to keep these walls from falling even when broken.

The brittleness of exterior terra

BRICKWORK showed numerous failures. This type of damage attributed to weak mortar and poor workmanship.

cotta and interior plaster was well illustrated by its cracking when the structural frames were subjected to a swaying motion. Although columns and beams were uninjured, the facing of many buildings was spalled and cracked, and the interior plaster was shattered for many floors. This cracking also extended into the tile partition walls. The terra cotta failures were mostly confined to the lower floors, where the shear stress was most severe. This effect also caused the breaking of many glass windows on the ground floors of buildings.

Damage to ordinary residences was comparatively slight. The shaking down of chimneys was general. Houses on weak or rotten timber foundations were frequently damaged

TOTAL COLLAPSE of building rarely occurred, even when the walls were destroyed. In general, the timber roofs showed remarkable strength.

ferior construction. With a few exceptions they were of brick, with timber floors and roofs. In many cases even one-story shop buildings were destroyed.

A particular feature in connection with the schools was the architectural treatments over doors that fell upon front steps and walks. The attempt to make schools monumental in appearance had neglected their safety.

In general, engineers and construction men who inspected the damaged area believe that the disaster of March 10 produced no new information on the effect of earthquakes on building construction but merely reemphasized facts already known. The result, however, will undoubtedly be some new code restrictions, at least in southern California, with

WAREHOUSE WALL destroyed. Lack of lateral support due to ineffective tie provided by ends of timber joists.

INDUSTRIAL BUILDING FAILURE, showing almost complete demolition of end walls and dropping of window sash.

STEEL DOORWAY BEAM drops at one end when brick support crumbles. Damage shown is typical of single-story structures.

was turned off immediately after the shock to prevent fires and was not restored for a week until odorizing plants were installed, as the supply is an odorless natural gas.

Damage sustained by school buildings was an outstanding feature. Aroused public sentiment is demanding a better grade of school building

POOR FOUNDATIONS were the cause of this damage. In general, residential structures survived the earthquake shocks.

FALLING BRICK from insecure parapet or fire walls caused many fatalities when people rushed from buildings to streets.

by being shaken on to the ground, although in most cases the frame was not seriously damaged.

Municipal facilities were not extensively damaged. The water supply of Long Beach was in operation the day following the earthquake, although people were being requested to boil it for drinking purposes because of possible contamination due to broken mains. The gas supply

construction. The fact that the earthquake did not occur during school hours probably resulted in saving the lives of hundreds of children. The reasons for this extensive damage are

not different from the general causes of other damage and lie in the fact that many of the school buildings, from the point of view of resistance to earthquake damage, were of in-

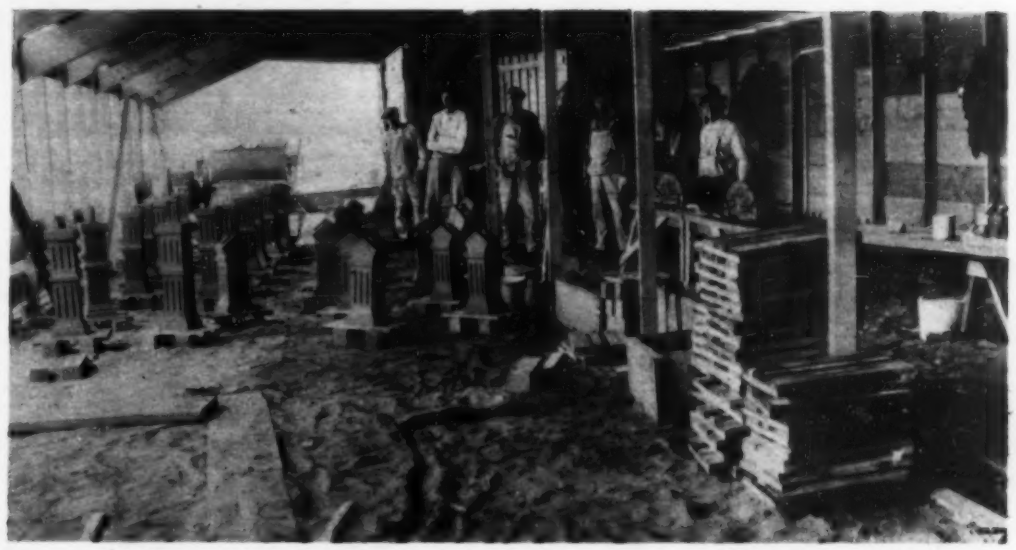
reference to the type of construction permitted for schools and, in general improvement of brick construction, reduction of the amount of architectural material or anchoring it more securely with ties.

In severity, it is estimated that the shock, affecting a limited area, was about the same as the Santa Barbara earthquake of 1925 and did not reach a velocity of 0.1 gravity.

Getting Down to DETAILS

Close-up Shots of Job Methods and Equipment

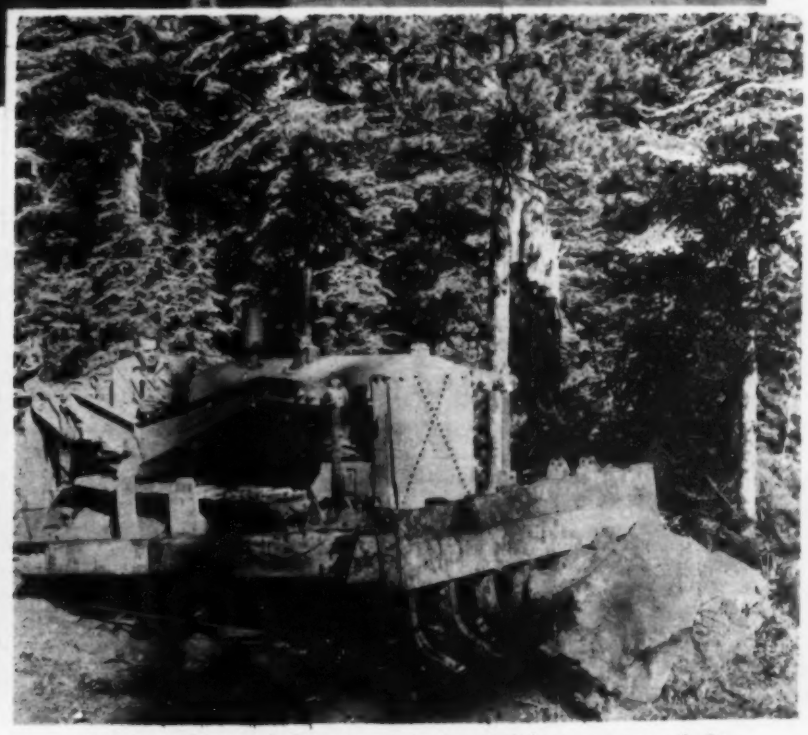
PADDED ROLLER (*below*), saturated from tank mounted above it, applies solution of lime or calcium chloride and starch to surface of newly laid paving brick, preventing top surface adhesion between brick and bituminous joint filler, so that excess asphaltic filler material can be peeled off and used again.



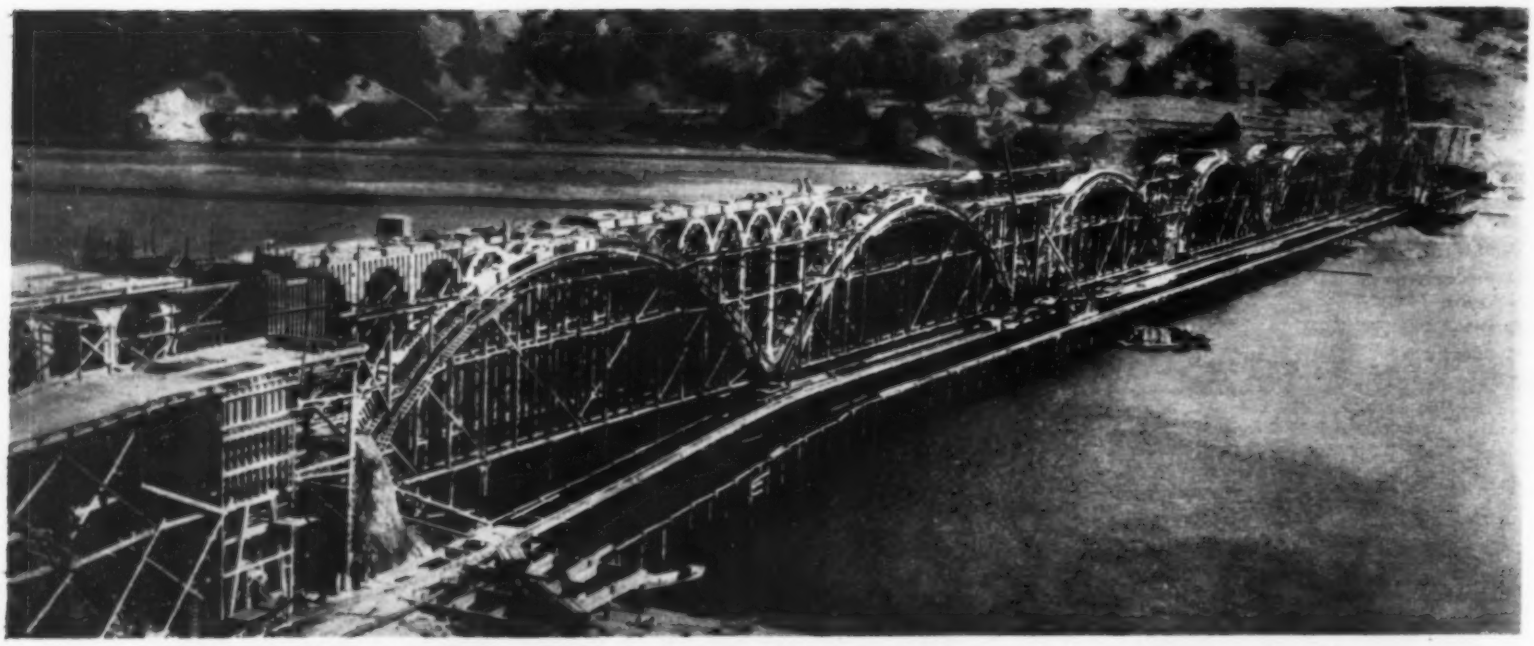
PRECAST HAND-RAIL VERTICALS for multiple-arch concrete bridge across Rogue River in Oregon. These units are capped by cast-in-place coping between cast-in-place posts over each arch spandrel column, as described in detail elsewhere in this issue.

SHOULDER BUILDING ATTACHMENT *(right)* is operated in combination with Western elevating grader. Device shapes road shoulder accurately, delivering excess material to conveyor belt of grader for removal by truck.

CAR UNLOADER saves time on Pennsylvania rural road-building project. Inclined belt conveyor is rigged to receive slag discharged from hopper-bottom railway car and transfer it to motor truck for delivery to job.



ROCK ROOTER BLADE is attached to bulldozer on one of the Allis-Chalmers tractors operated by the U. S. Forest Services for building roads in Mt. Hood National Forest, near Portland, Ore.



ARCH CENTERING on piling in place for concreting seven 230-ft. spans of Rogue River bridge. Trestle carries industrial and wide-gage track on which movable concrete chuting tower (in background) operates.

Concrete Arch Ribs of Rogue River Bridge DECENTERED BY BUILT-IN JACKS

By G. S. PAXON and MARSHALL DRESSER

Field Engineer *Resident Engineer*

Bridge Dept., Oregon Highway Commission

RIVER PIER CONSTRUCTION involves use of two piledrivers, concrete hoisting tower, five derricks and industrial track on trestle. In foreground, sheet pile cofferdam for pier is partially completed.

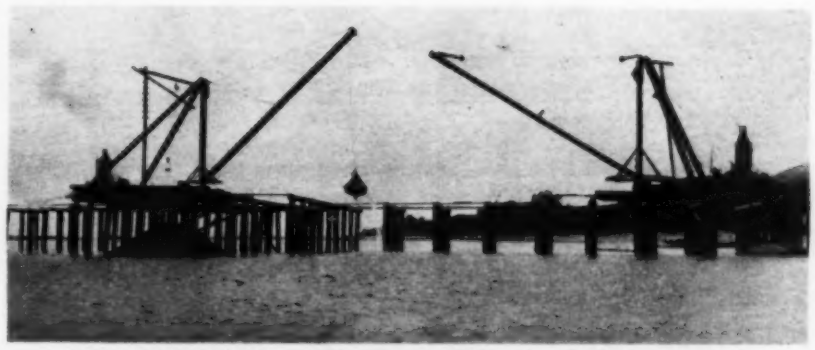
USING the Freyssinet method of arch decentering and stress adjustment for the first time in the United States, the Oregon State Highway Commission has erected a bridge across the mouth of the Rogue River, in the southwest corner of the state, to replace a ferry. The structure forms an important link in the Oregon Coast Highway and consists of seven 230-ft. reinforced concrete arch spans with 164 ft. of concrete viaduct approach on each end, making a total length of 1,938 ft. for the complete river crossing.

Contract for $568,181, awarded to the Mercer-Fraser Co., of Eureka, Calif., called for completion in two working seasons. The schedule provided for constructing all river foundation work the first season and arch spans and superstructure the following year. The stream bed was found to be composed of a fairly compact mixture of sand and gravel which necessitated a pile foundation. The seven arch spans are divided into three groups, a three-span group in the center flanked by two two-span groups, with the intermediate abutment piers resting on batter piles.

Design—The arch spans were designed and constructed by the method developed by Ernest Freyssinet, an eminent French bridge engineer. While this system has been used successfully in France, this is its first application in the United States. Briefly, it consists of leaving out a short section of arch rib at the crown and inserting a set of hydraulic jacks which are used: (1) to lift the ribs off the centering; (2) to adjust for any deviation from design caused by shrinkage of the concrete, elastic rib shortening due to dead load, or pier

displacement; and, (3) by artificially produced stresses, to compensate for anticipated shrinkage and temperature stresses.

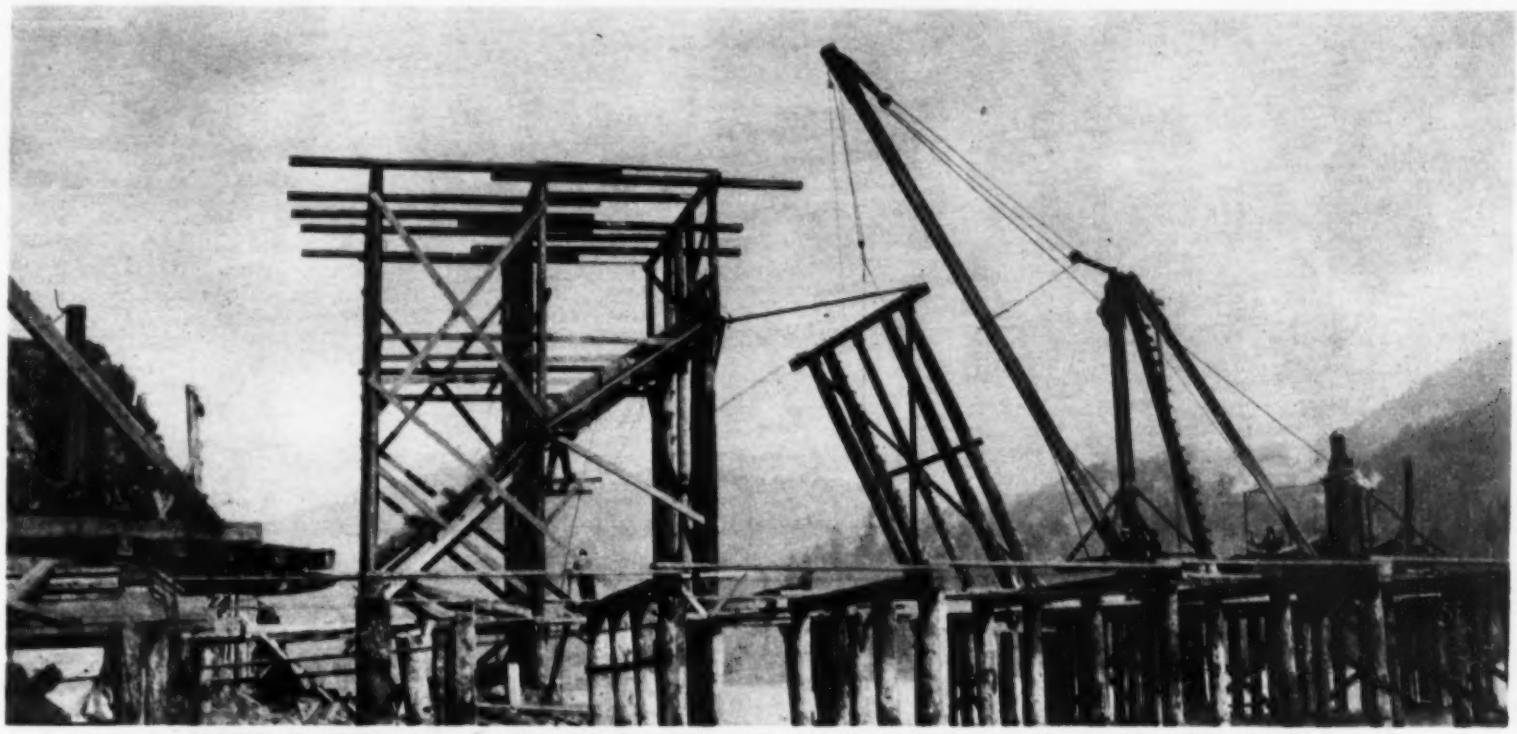
The site of the Rogue River Bridge is 80 mi. from the nearest railroad. There is, however, an available harbor at Port Orford, 30 mi. north, whence all cement and metal reinforcement, delivered by boat, were trucked to the job. Lumber was obtained from mills at Bandon, 60 mi. north of the site. Piling was obtained locally, and concrete aggregates were taken from the river near the bridge.



PIER EXCAVATION preliminary to building of cofferdams is handled by clamshell buckets on booms of stiff-leg derricks.

Vulcan steam hammer. Since the material tightened considerably, due to pile driving, alternate piles only were driven on the first trip over the foundation, and the intermediate piles were driven on a second trip. This procedure gave practically uniform penetration over the entire foundation area.

Intermediate abutment piers Nos. 3 and 6, were founded on piling driven on a batter which paralleled the resultant of the pier weight and the thrust line of the arch rib. These piers presented a more difficult problem than the others, inasmuch as it was necessary to design the interior cofferdam bracing so that it would not interfere with the pile driving, and also because it was necessary to cut off one-half of the piles before the other half of the foundation could be driven. This was accomplished by a diver with an air-driven saw.



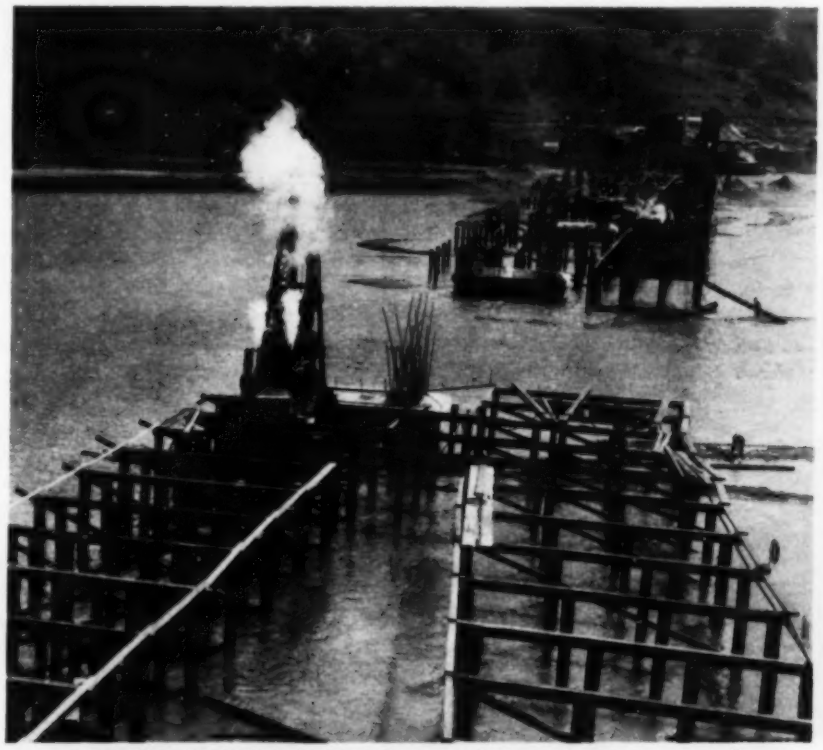
ASSEMBLED BENTS of round timber for arch centering of Rogue River bridge are erected as units by stiff-leg derrick on top of capped falsework piling.

Materials, as received, were stored in a well planned material yard and conveyed to the job by a 24-in. gage industrial railroad.

Excavation for Piers—All excavation was made by derricks and clamshell buckets from falsework alongside the structure; this falsework also supported an industrial railway. The contractor used five live-boom derricks in order to complete the six river piers before winter high water.

In the case of each pier, excavation was completed before wooden cofferdams were placed. The 14x18-in wale timbers and 12x12-in. interior bracing were put together and floated into position, each set of frames being placed with a derrick successively on top of the lower frame spreader posts. As soon as the interior construction was complete, 8x16-in. splined sheet piling was set up completely around the frame and then driven with a derrick equipped with swinging leads and a 2,800-lb. drop hammer. The sheet piling was milled with a 2x3-in. groove in each edge and joined by a 2x6-in. wooden spline.

The foundation piling then was driven on 2 ft. 6 in. centers with a



FALSEWORK PILING is driven by steam hammer rigs to support arch centering and also carry industrial and 30-ft. gage track for delivery of materials and operation of concrete chuting tower.

Seal concrete then was placed with a 10-in. tremie handled by a steam derrick. The type of cofferdam described was successful. It is interesting to note that even though four of them were 32x39 ft. inside and two, 41x57 ft. inside, a 6-in. centrifugal pump was more than ample to keep any one of the holes dry under a 25-ft. head of water. Seals were made 7 ft. thick, or only about half the weight necessary to balance the hydrostatic head, dependence being placed on the bond between the piles and the seal concrete. The piles were cut off at the top of the seal after the cofferdam was unwatered.

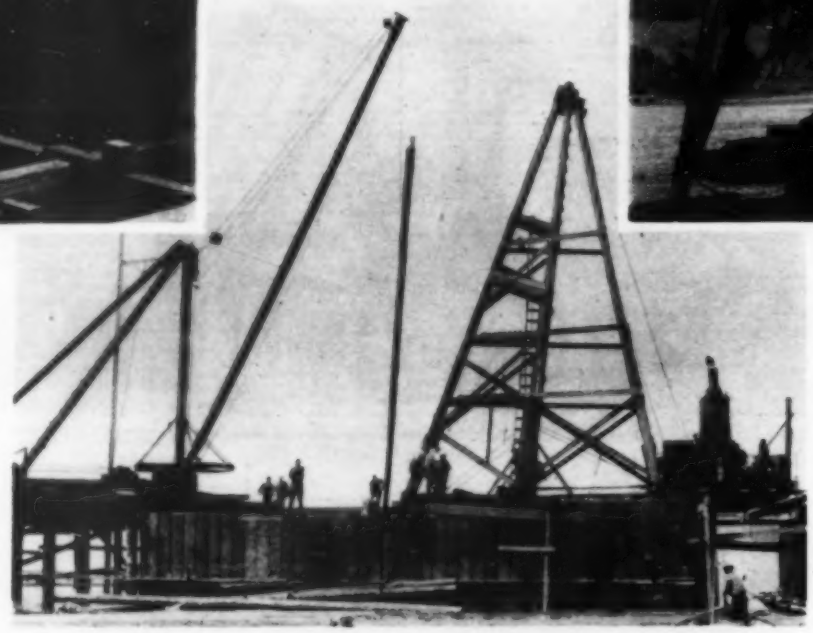
Concrete Plant—The concrete plant was placed on the north bank of the river alongside the approach and connected by a spur line to the industrial railroad serving the mate-

SWINGING LEADS and drop hammer aid driving of 8x16-in. splined sheet piling for pier cofferdams.

rial yard. Trucks delivering concrete aggregates drove up an incline and dumped into bins above the mixer. From there the required amount of each size was weighed out cumulatively in a steel hopper connected to a Fairbanks-Morse dial scale. Cement, delivered in cloth bags, was dumped into the hopper from a platform alongside the aggregate bins. From the weighing hopper the batch went by gravity to a 27-S Foote nontilting mixer and then into concrete cars operating on the industrial railroad. The mix was so designed as to result in a smooth grading curve. All concrete was mixed 2 min. Concrete for piers, columns, and beams was designed for 2,500 lb. per square inch compressive strength in 28 days, and contained 5 sacks of cement per cubic yard, with a water-cement ratio of 0.80. Concrete for deck slabs was designed for 3,000 lb., contained 5½ sacks of cement per cubic yard, with a water cement ratio of 0.75. Arch rib concrete was designed for 5,000 lb. and contained 8¼ sacks per cubic yard, with a water cement ratio of 0.60.

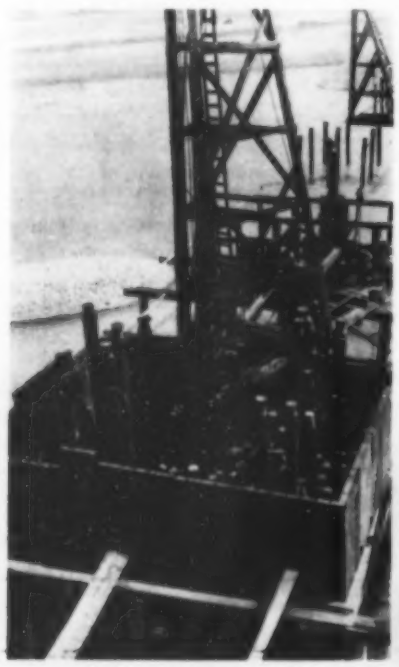
The concrete was elevated through a wooden tower and distributed by an Insley counterbalanced chuting system hung from the tower. At some places inconvenient to reach with a down spout from the chute cart haul was employed. The tower used during the first season's work in placing the pier concrete was 80 ft. high and moved on skids alongside the industrial railroad paralleling the structure. For the second season's work the tower height was increased to 104 ft., and the tower was carried on car wheels on a 30-ft. gage railroad. The base supporting the concrete tower was built up high enough so that the cars on the industrial railroad passed underneath, permitting delivery of material to points beyond the tower.

BATTER PILES, required at the intermediate abutment piers, are driven by special rig.



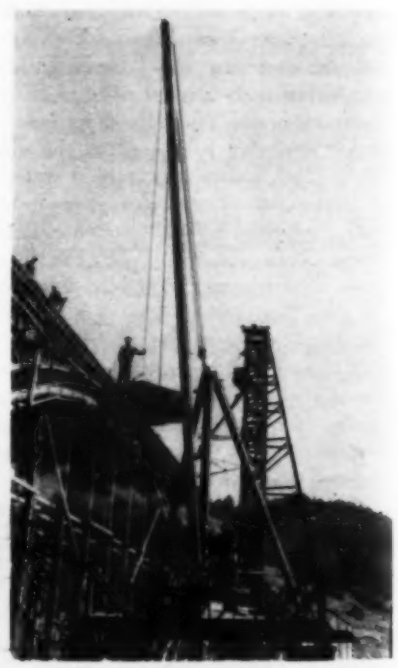
FOR ABUTMENT PIERS piles had to be driven at a batter within the sheet-pile cofferdams.

Finishing was done by two electrically-driven Berg finishers, supplemented by hand rubbing in inaccessible places. The general procedure was to rub a thin coat of sand-cement grout into the surface of the concrete, allow this to set under proper curing conditions and then grind a second time.



WITHIN COFFERDAMS wood piles to support piers are driven by steam hammer.

JACKING BRACES *(below)* of structural steel which were encased in the arch ribs at the crowns.



TRAVELER DERRICK, on 30-ft. gage track, handles forms and steel reinforcement.

Hand Rail—The hand rail consists of precast verticals capped by a cast-in-place coping between cast-in-place posts over each arch spandrel column and rather massive pylons over piers Nos. 1 and 8. The making of precast members and the construction of the handrail was sub-let to J. F. Rhyner, of Portland, Ore. The forms for these precast members were wood lined with sheet metal and so arranged that they could be removed without causing damage and re-used immediately. The mix was set at 1 part of cement to 2¼ parts of sand screened through an 8-mesh screen. Diatomaceous earth, amounting by weight to 2 per cent of the cement, was added to the mix. The aggregate and cement were mixed in a revolving-blade Blystone 9-cu.ft. mixer similar to those used in mixing plaster.

Falsework—Falsework piling bents were driven on 14 ft. 4½-in. centers with a 3,000-lb. drop hammer and cut off and capped at El. 12. Falsework above this level consisted of round posts capped with square timbers supporting the arch rib stringers. Most of the round posts were salvaged from cut-offs of foundation piles which had been driven full length to avoid the use of a follower. About 90 per cent of the 8x16-in. sheet piling and other cofferdam timbers was salvaged from the foundation work and used for arch-rib support.

To facilitate falsework framing and rib-form building, a full sized outline of one arch rib was laid out on a level platform, sectional templets were made for the rib side forms, and direct measurements for falsework framing made. The falsework then was made up in single-bent units and erected with a derrick.

Forms—Form building was done in an open air shop adjacent to the material yard. This shop was equipped with a band saw, two DeWalt combination rip and cutoff saws, two electric portable saws for trimming the extrados arch-rib forms,

FINISHED SURFACE (*left*) of a portion of the north viaduct approach to the multiple-arch bridge.

and a power machine for filing saws. It was found practical to make up and match-mark in panels and transport to the structure about 85 per cent of the forms, thereby keeping hand carpentry work at a minimum. It is particularly noticeable that the form carpenters on the job were few, considering the amount of forms to be assembled. The extrados forms for the arch ribs were placed board by board as the placing of the concrete progressed so as not to interfere with the placing and tamping.

To facilitate shipping, the reinforcing steel was cut to the proper length before shipment, but not bent until after it was received on the job. The bending and placing of the reinforcing steel was sublet to Roy Saunders, of Sacramento, Calif.

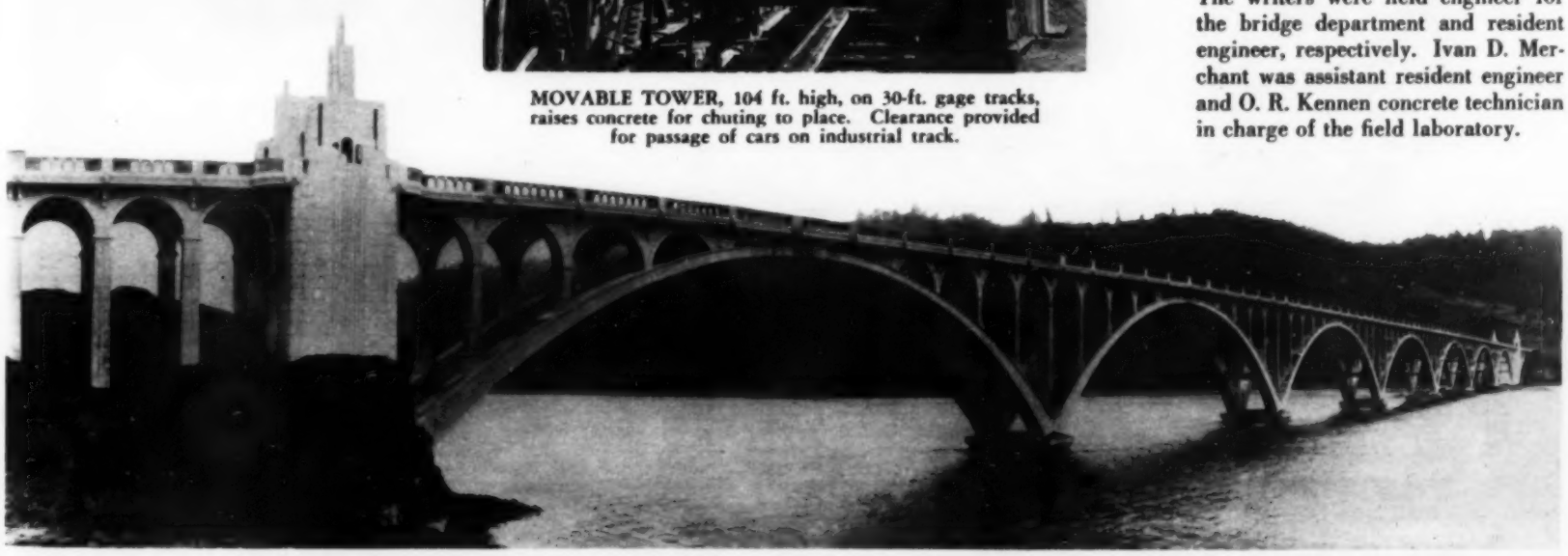
A stiff-leg derrick with a 60-ft. boom, the base of which was designed similar to that of the concreting tower so that industrial trains could pass under, and traveling on the same 30-ft. gage railroad, was used to good advantage hoisting reinforcing steel and form panels.

The general progress of the job and the quality of the work was satisfactory, due to the directing ability of James D. Fraser, president of the Mercer-Fraser Co., in personal charge.

Recognizing the possibilities of the Freyssinet system of arch adjustment, the U. S. Bureau of Public Roads cooperated with the Oregon State Highway Commission in experimental work in connection with the construction. Albin L. Gemeny, senior structural engineer, Division of Tests, and George W. Davis, associate testing engineer, represented the Bureau of Public Roads in this work.

Engineering and inspection for the Rogue River bridge was under the general direction of Conde B. McCullough, bridge engineer for the Oregon State Highway Commission. The writers were field engineer for the bridge department and resident engineer, respectively. Ivan D. Merchant was assistant resident engineer and O. R. Kennen concrete technician in charge of the field laboratory.

MOVABLE TOWER, 104 ft. high, on 30-ft. gage tracks, raises concrete for chuting to place. Clearance provided for passage of cars on industrial track.



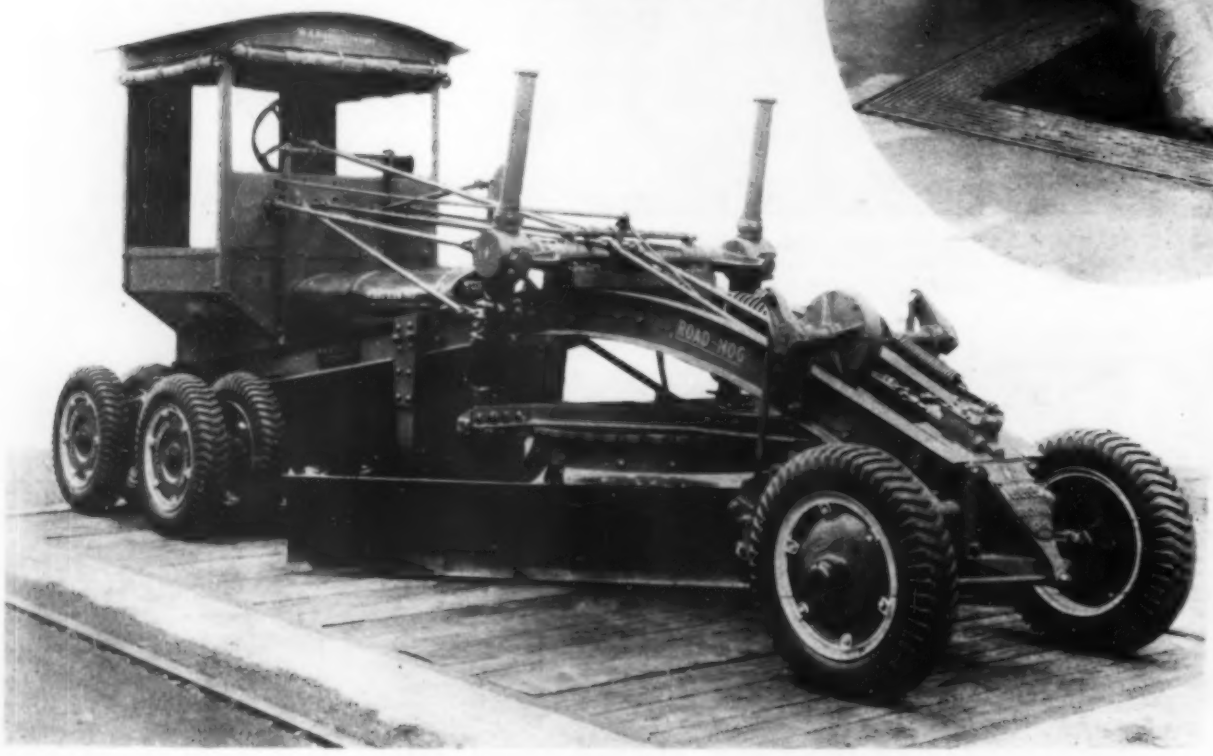
SEVEN TWO-RIB CONCRETE ARCHES, each of 230-ft. span, carry Oregon Coast Highway across the Rogue River. At each end is a 164-ft. viaduct approach section. Total length of bridge, 1,938 ft.

FULL POWER CONTROL, assuring ease in operating elevating grader, is accomplished by four power levers, mounted on gear box, which control adjustments of carrier and plow. All operating controls, including clutch, throttle and gong, are grouped within easy reach of operator's seat. Other features: Arched A-frame giving ample clearance for carrier and permitting higher lift for loading large wagons; a 46-hp. engine mounted on sub-frame at left of rear axle; steel carrier, 19 ft. standard size, which may be increased to 22 and 25 ft. by adding 3-ft. extensions; "free floating" plow beam, a 675-lb. built-up box section suspended on chains to protect plow from hidden obstructions and permit easy adjustment; ball and roller bearings; non-clogging drum-type wheels; extensible axles balance weight of carrier. —Caterpillar Tractor Co., Peoria, Ill.

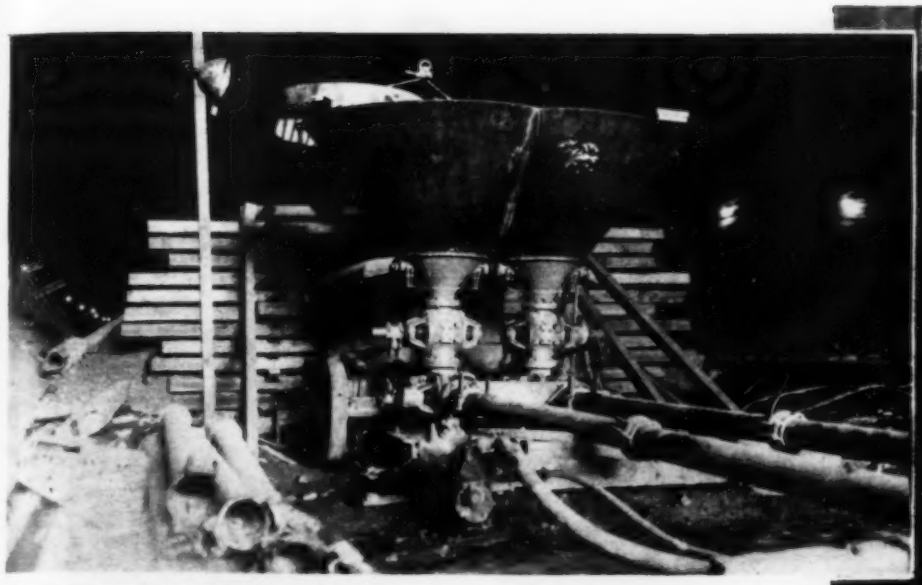
NEW EQUIPMENT

On the Job

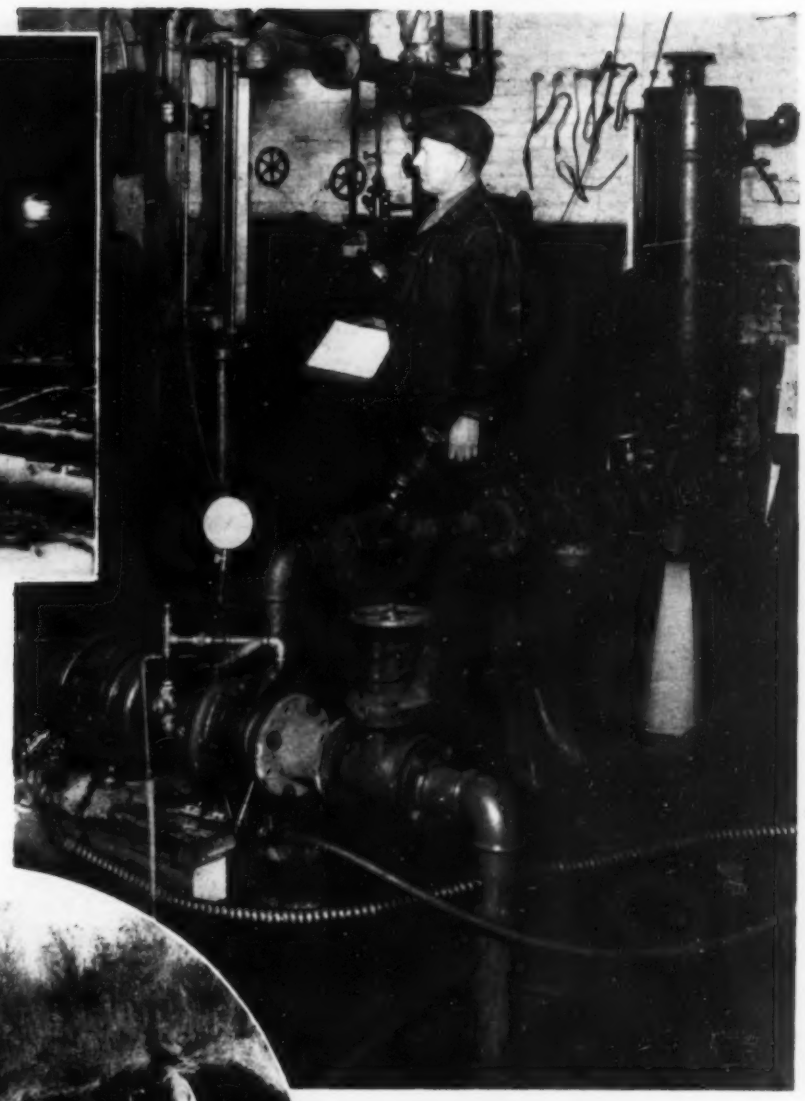
SELF-CLEANING, HERRINGBONE TREAD of pneumatic, lug-type tractor-grader tire (*below*) gives positive, sharp-edged gear wheel traction and assures straight forward motion with no side creeping. Tire carcass insulated with heavy gum coatings between each cord ply to eliminate possibility of bruises in severe service. Thick tread resists abrasion and cutting by sharp stones.—B. F. Goodrich Co., Akron, Ohio.



FOR VENTILATING MANHOLES (*above*), tunnels and other enclosed places where electricity is not available, portable blower powered by ¼-hp. air-cooled gasoline engine operating at 1,800 r.p.m. delivers 1,550 cu.ft. of air per minute. Mounted on heavy coil springs to cushion vibration of single cylinder engine. Air flow can be directed to any desired point by 8-in. diameter flexible tubing of proper length. Adjustable discharge eliminates elbows in this duct. Weight, 105 lb. Can be set up in any space 2 ft. square. —Coppus Engineering Co., Worcester, Mass.



CONCRETE PUMPED TO FORMS through 5- or 6-in. pipe line (*above*) by direct action of Pumpcrete, a portable piston-type gasoline or electric motor driven pump. Pumps concrete with slump as low as 3 in. and with aggregate up to 2½ in. at rate of 20 to 40 cu.yd. per hour over any distance up to 500 ft. or to a height of 75 ft. Pipe line may be cleaned by plunger-like device forced through pipe under water pressure. Pipe lengths 10 ft., joined with toggle-type couplings. Flexible end pipe section for reaching down into forms or spreading over wide area. —Chain Belt Co., Milwaukee, Wis.



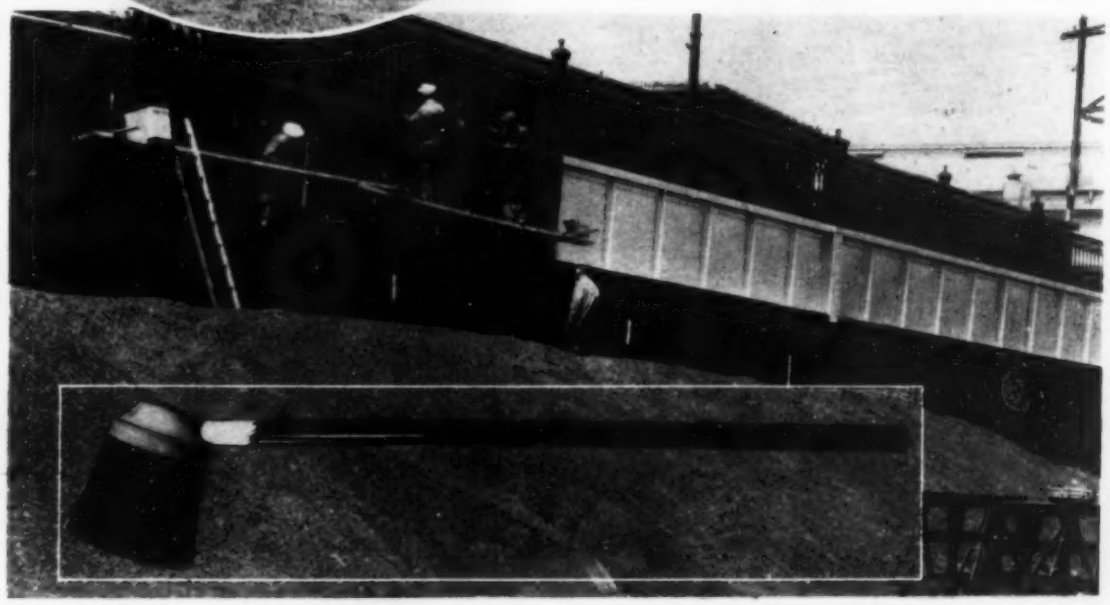
SINGLE-SUCTION PUMP (*right*) for general service and sewage work, designed with Nash built-in self-primer, mounted as integral part of cast-iron pump casing. Bronze-covered pump shaft is extension of motor shaft carrying impellers for pump and primer. No bearings used in pump and no coupling is required. Two types of impellers available: open type for sump service or where liquids are not clear, and closed type for clear liquids. Built in capacities up to 450 g.p.m. and for heads up to 150 ft.—Buffalo Pumps, Inc., Buffalo, N. Y.

POWER WHEEL LEANING, (*left*) relieving operator of muscular effort, is new feature of 12-ft blade grader. Power to lean wheels is taken from one front and one rear wheel through hollow spindles from which universally connected shafts lead to gear cases containing clutches. Blade is 23 in. high, stiffened with 90-lb. railroad rail. One-piece frame insures strength and rigidity. Blade may be side-shifted by ratchet lever operated from ground. Visibility feature enables operator to see both ends of blade. Point of blade can be dropped 18 in. below front wheels.—Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, Ill.

If You Want Further Information—

Within the space limits of this page it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.



ALUMINUM COATING (*right*) carried by bituminous paint vehicle is applied by Department of Plant & Structures, New York City, to protect 1,500-ft.-long steel viaduct serving ferry terminal at St. George, Staten Island. Dual function performed when anti-corrosive black base primes surface, penetrating and sealing pits and pores of metal, while aluminum flakes, rising to surface of coating, "leaf" out to form decorative, durable metallic finish. Special Osborn blunt-headed brush (*insert*) allows paint to be "flowed on" uniformly, preventing streaks caused by brushing in with flat brush. —Quigley Co., Inc., 56 W. 45th St., New York.

Present and Accounted For —

A Page of Personalities

ILLINOIS HIGHWAY CHIEF. Ernst Lieberman, member of the firm of Lieberman & Hein, consulting engineers of Chicago, is the new chief highway engineer of Illinois, succeeding Frank T. Sheets. He is a graduate of Armour Institute of Technology and has had extensive experience in the design and construction of reinforced concrete structures. During recent years his work has been mainly that of a consultant on building construction and materials.

HEADS MUNICIPAL ENGINEERS. Samuel A. Greeley is this year's president of the American Society of Municipal Engineers. A graduate of Harvard and of M.I.T., he is a member of the firm of Pearse, Greeley & Hansen, consulting engineers, Chicago. He is a specialist in the design and construction of water supply and sewerage works.

MINNESOTA'S NEW COMMISSIONER. N. W. Elsberg is the newly appointed head of the State Highway Commission of Minnesota, succeeding Charles M. Babcock. He is a graduate of the University of Minnesota, and after engineering service on a number of bridge construction projects, including the Cappelen Memorial Bridge in Minneapolis, was named city engineer of Minneapolis, a position he filled for eleven years.

MISSOURI CONTRACTORS' PRESIDENT. H. J. Massman, president of the Massman Construction Co., of Kansas City, Mo., has been elected president of the Associated General Contractors of Missouri. His thirty years of construction experience include extensive railroad and highway work and large contracts on the Missouri and Mississippi Rivers.

HIGHWAY OFFICIALS' LEADER. Charles H. Moorefield, state highway engineer of South Carolina, is serving as president of the American Association of State Highway Officials. He is a native of Virginia and a graduate of Virginia Polytechnic Institute. His experience includes railroad and bridge work and service, as highway engineer, with the U. S. Office of Public Roads.

Often ...the REX JACKASS HOIST and One-Man Jiffy Spout

found on the Rex Moto-Mixer alone Mean the Margin Needed to Get the Job in these Days of

"Close Figuring"

Time—Time—Time—in any stage of construction, the man that saves time saves money—money needed to provide the margin that represents the difference between profit and loss. Often, the Rex Jackass Hoist and One-Man Jiffy Spout provide the Central Mixing Plant with the margin needed to meet competitive prices—and get the contractor's business.

Nobody Loses . . .

And the contractor — whether he owns his Moto-Mixer or buys concrete delivered—saves money too. For with the Rex Jackass Hoist and One-Man Jiffy Spout, the concrete is spouted over an area 75% greater than possible with the flat discharge and can be discharged more accurately —just as wanted. Often the Jackass Hoist means the difference between delivery direct to the forms and the building of ramps and the cost of a wheeling job.

Investigate these two features — patented by the Chain Belt Company and found on the Rex exclusively—Get them now—don't wish you had them later for "close figuring." To the many features of the Rex—they add these great advantages that cannot be obtained elsewhere.

The Jackass Hoist—Raises the mixer discharge to 8 feet, increasing spouting area 75%—often cutting the cost of concrete in the forms 25% to 50% or more in eliminating ramps and wheeling.

The One-Man Jiffy Spout—Saves 2 to 5 minutes on every spouting job. On the road, it replaces one fender at no increase in weight —on the job it swings on hinges; a one-man, 15-second job.

In the building of Hoover Dam, 14 Rex Moto-Mixers, 100 tons of Rex-Stearns Idlers, and the Rex Pumpcrete—are all contributing their savings today. Address:

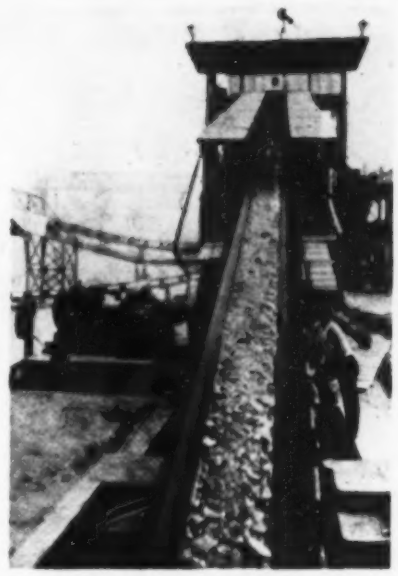
REX MOTO-MIXERS AND AGITATORS — JOB MIXERS — PLANT MIXERS — PAVERS BELT CONVEYORS ELEVATORS — CENTRAL PLANTS ROAD PUMPS SPEED PRIMERS SAW RIGS

CHAIN BELT COMPANY :: 1664 W. Bruce Street :: MILWAUKEE, WIS.

Cable Address: Beltchain

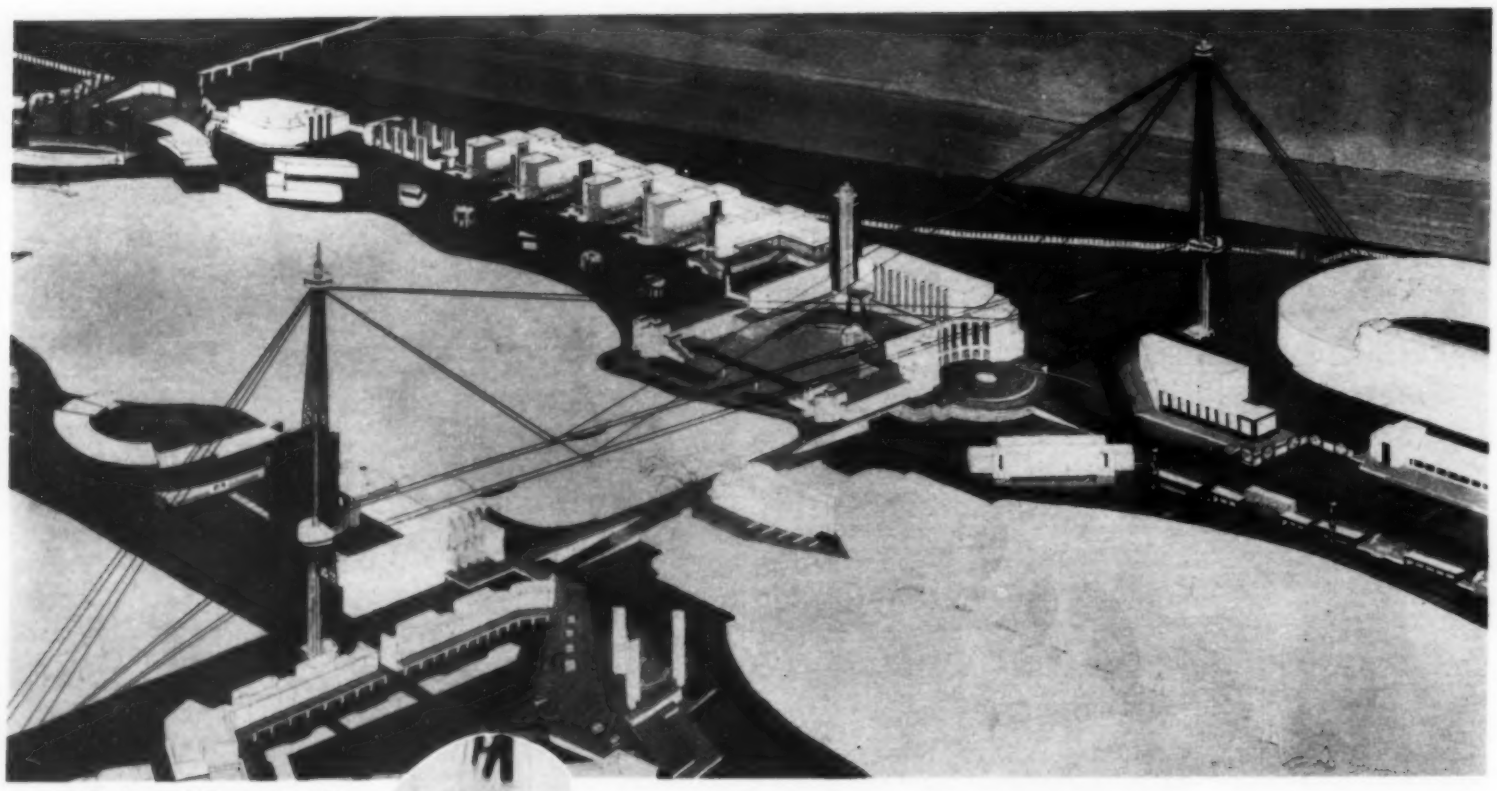
REX MOTO-MIXERS Reg. U.S. Pat. Office

MIXERS: 1 YD. 1½ YD. 2 YD. 3 YD. 4 YD. 5 YD. ***AGITATORS:*** 1½ YD. 2 YD. 3 YD. 4½ YD. 6 YD. 7 YD

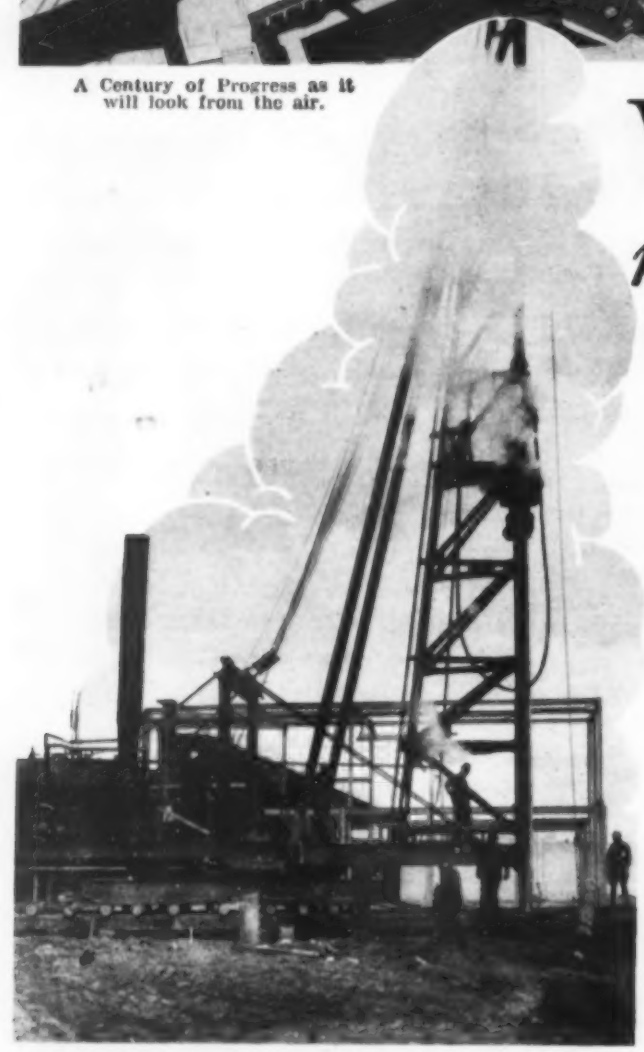


100 tons of Rex-Stearns Timken Idlers are in operation in the aggregate and mixing plants at Hoover Dam.

14 Rex Moto-Agitators are working at Hoover Dam. The Rex Moto-Agitator detached from motor truck is moving by the air route to the pouring platform.



A Century of Progress as it will look from the air.



Warrington Vulcan Pile Hammer driving piles for the foundation of the Agricultural Building at A Century of Progress. Walsh and Masterson, Contractors. Interesting is the welded steel pile frame, without rivets, that has been rendering exceptional service.

VULCAN *helps materialize a* VISION

Growing out of a barren area of clay and sand, with blue Lake Michigan for a background, is a fantastic city of the future, new, virile—leaping decades ahead of the calendar. Chicago's Century of Progress is taking form, preparing to startle the world with its beauty, as another generation was startled by the ecstatic vision created for them forty years ago in the same city.

A Century of Progress is modern in every respect. New materials, new methods, new forms and new finishes identify it with this twentieth century.

The speed with which construction of this wonder city of the generation has been advanced, has attracted the attention of engineers everywhere. Practically all the piles for foundations of these buildings were driven by Warrington-Vulcan Pile Hammers. Over 200,000 lineal feet of wood piling, up to 75 feet in length were driven. As ever the principle of heavy mass and low velocity incorporated in Vulcan design proved itself the successful combination for speedy and economical results in pile driving.

VULCAN IRON WORKS

327 No. Irving Avenue, CHICAGO, ILLINOIS

Southern Representatives:
Woodward, Wight & Co., Ltd., 451 Howard Avenue, New Orleans, La.
Representatives for California, Nevada and Japan:
Harron, Rickard & McCone Co., 1600 Bryant St., San Francisco, Calif.
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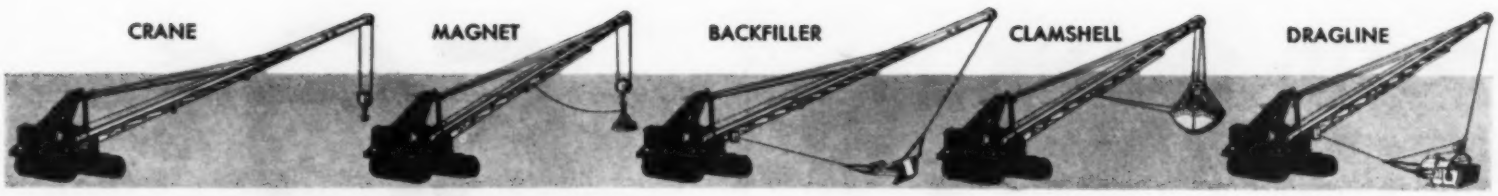
A. H. Cox & Co., Inc., 1757 First Avenue, S., Seattle, Wash.

Warrington-Vulcan
PILE HAMMERS



WANTED—a Tough Job!

Just a few minutes are required to place the BADGER on its wheel mounts, ready for rapid traveling. Compute shovel capacity on earth moved per hour—not bucket size.

—cramped working quarters
—long jumps between jobs

by the AUSTIN BADGER SHOVEL

Here is a machine that is looking for the meanest jobs you have!

It is not just a big shovel cut down to small cubic capacity. Instead it is designed from the ground up to fill your needs for a machine that can be placed on the job quickly—and that is small enough to work freely in places where a big shovel could not even get in.

You can buy a BADGER Shovel for less than the upkeep on some of the shovels you are now using. When conditions require, a very small expenditure will convert it into a CRANE, MAGNET, BACK-FILLER, CLAMSHELL or DRAGLINE.

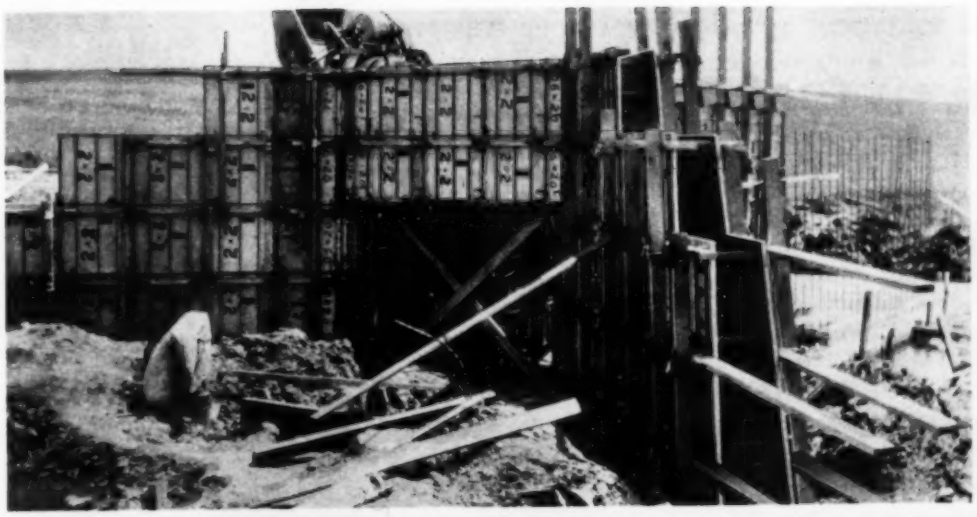
Write for the New BADGER Catalog—just off the press. See this lively machine at work on jobs that stop heavier equipment.

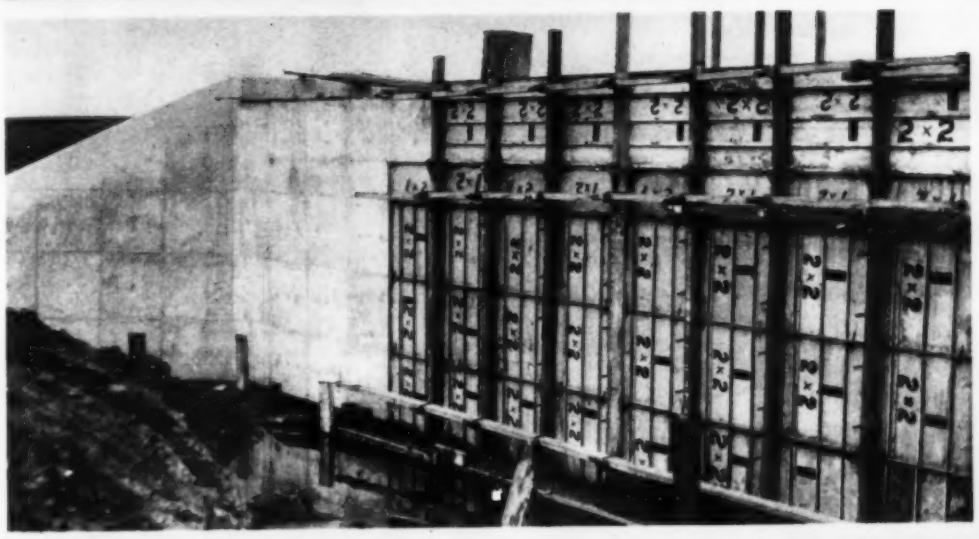
The Austin-Western Road Machinery Company. Home office, 400 N. Michigan Ave., Branches in principal cities.

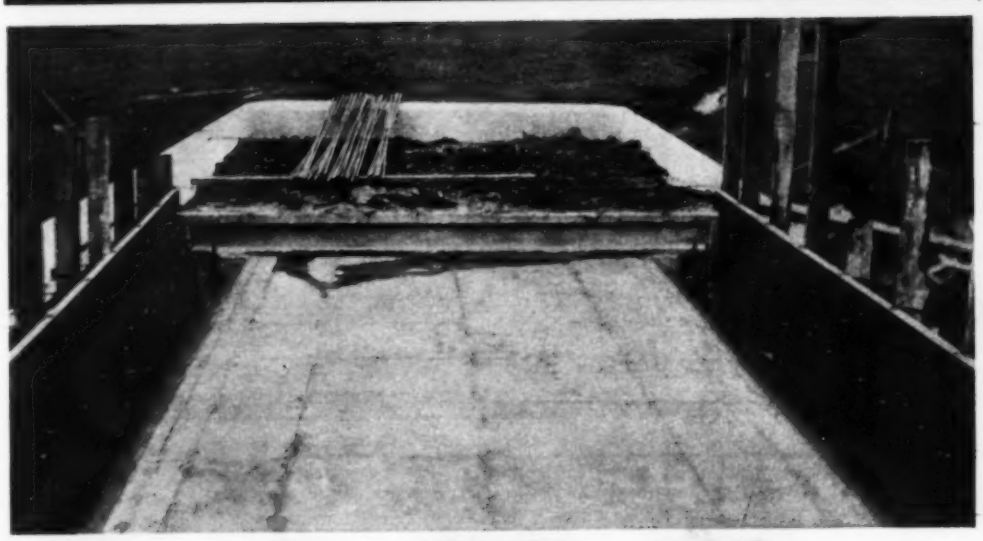
105

The Austin-Western ROAD MACHINERY CO.

ROAD ROLLERS, CRUSHING & SCREENING PLANTS, SCARIFIERS, SWEEPERS & SPRINKLERS, ROAD GRADERS, ELEVATING GRADERS. MOTOR GRADERS, PLOWS & SCRAPERS, BITUMINOUS DISTRIBUTORS DRAGS, SHOVELS & CRANES, DUMP WAGONS, SNOW PLOWS.







Building A Standard 8′×8′ Box Culvert, Complete, with Metaforms

Abutment Wing angles formed with hinged Metaform units.

Only standard Metaform units used.

Time and material saved will pay for Metaform equipment quickly.

If you work with concrete, ask for full information.

Metal Forms Corporation
Milwaukee, Wis.

SAVE *with* Metaforms

Manufacturers of these trucks, tires, locomotives, haulage and automotive equipment used 233 pages of advertising in *Engineering News-Record* and *Construction Methods* last year.

This was 61% more space than these manufacturers used in five other publications in the engineering-construction industry.

A greater volume of this class of advertising will appear in *Engineering News-Record* and *Construction Methods* during 1933.

The engineering-construction industry is the second largest fleet user of trucks.

A recent investigation among buyers in the engineering-construction field reveals that *Engineering News-Record* is publication No. 1 and *Construction Methods* publication No. 2. All other media (industrial as well as general) trail far behind.

ENGINEERING NEWS-RECORD
CONSTRUCTION METHODS
McGraw-Hill Publications.
330 W. 42nd St., New York

Take the GUESS out of CONCRETE CURING

AN UNSATISFACTORY paving job doesn't do the contractor's reputation any good. Nor does it reflect credit on the officials accepting it, after use begins to disclose its defects.

So, why gamble with uncertain methods? Why, particularly, permit elaborate foundation work and high-grade materials to be jeopardized in the final stage of concreting operations, viz. *curing?* Why forever deal with the factor of workmen's indifference or inexpert judgment which usually presents itself with dirt or straw curing methods? Why take risks of uneven covering; insufficient moisture; neglected re-wetting; premature drying out and shallow cure in spots?

Calcium Chloride takes not only the guess out of concrete curing, but a huge part of the expense as well. No straw to buy and handle. No dirt to haul and shovel. No wear and tear on trucks and other equipment. No maintaining elaborate piping and pumping system for re-wetting. No heavy supervision and inspection expense. No clean-up work.

With Calcium Chloride one reliable man with an inexpensive wheel spreader can do everything necessary to assure a positive, even and complete cure. He simply removes the wetted burlap; then spreads the Calcium Chloride, which thenceforth provides its own moisture (from the air) to carry on the curing process. By coating the surface it also keeps the mixture from "breathing," prevents the evaporation of internal moisture, accelerates the set and assures a thorough cure of the slab's entire depth. No other method in the world is so simple and certain!

Curing with Calcium Chloride is approved by the U. S. Bureau of Public Roads. Laboratory tests have been exhaustive. Extensive mileage has been cured, checked and compared with other processes. Calcium Chloride surface curing (1) does not create volume changes that cause surface cracks; (2) does not cause scaling; (3) permits use of the average pavement in half the normal time. For complete information regarding Calcium Chloride concrete curing — both surface and in-the-mix methods — write to any of the following members of the

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MICHIGAN ALKALI COMPANY
10 E. 40th St., New York City

SOLVAY SALES CORPORATION
61 Broadway, New York City

THE DOW CHEMICAL COMPANY
Midland, Michigan

THE COLUMBIA ALKALI CORPOR'N
Barberton, Ohio

Calcium Chloride

FOR MODERN CONCRETE CURING

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SEARCHLIGHT SECTION

NOW prove for yourself that this cable is TOUGH

TELLURIUM COMPOUNDED

TRY TO TEAR THE JACKET We have told you that this G-E portable cable is tough. Now we offer a simple and easy way to test it yourself. Try to tear the jacket with a pair of pliers. You may be able to, but by doing so you will get a good idea of the quality of the cable and why it is able to stand all sorts of rough usage. Your jobber carries in stock most of the standard sizes and will gladly allow you to make this test.

PORTABLE CABLE MUST BE TOUGH Cable that is dragged along after electric shovels . . . hit by picks and shovels . . . run over by trucks and tractors . . . must be resilient and tough.

WHY THIS G-E CABLE IS TOUGH The rubber in the 60-per-cent all-rubber jacket is tellurium-compounded. This process results in a jacket similar to that used for the rubber tread of automobile tires, improves the rubber, toughens it, enables the jacket to resist abrasion, and greatly increases the life of the cable.

ALL TYPES You can get G-E portable cable with this tellurium-compounded rubber jacket in all types and sizes up to 6600 volts; also, with braided finishes up to 600 volts.

General Electric manufactures insulated cable of every type, size, and voltage for every application. If your jobber cannot supply you, address the nearest G-E office, or General Electric Company, Schenectady, N. Y.

The coupon is for your convenience in asking for prices and information on portable cable. Send it to the nearest G-E office or Schenectady, N. Y.

MORE PROOF THAT THIS CABLE IS TOUGH

HOOVER DAM

Seven miles of this G-E cable serves the shovels on this great construction job. The service is most severe. Sharp rocks, trucks and tractors, picks and shovels, very dry atmosphere, temperature up to 140 deg. F.—yet this cable is standing up satisfactorily.

FOR PRICES AND INFORMATION

GENERAL ELECTRIC COMPANY
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Gentlemen: Please send me a copy of GEA-1728 (price sheet) and of GEA-1733 (bulletin) on "Portable Cable."

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Company .....

Address .....

City ..... State .....

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GENERAL ELECTRIC

Its Strong Thirst

makes it useful to road builders

in two ways

Because of the readiness with which TEXACO Calcium Chloride attracts and holds moisture, it is valuable to road builders both as concrete curing agent and as dust layer.

In concrete curing, either applied to the surface or incorporated in the mixing water, TEXACO Calcium Chloride insures high early strength, less delay in admitting traffic to the pavement, quicker release of forms. When curing has been completed with this material, no cleaning up is necessary. The use of TEXACO Calcium Chloride is simple and a uniformly cured slab results.

Its moisture-attracting quality also makes TEXACO Calcium Chloride an efficient, economical dust-layer. It eliminates dust and saves the surface of untreated gravel, waterbound macadam, sand-clay, cinders and similar roads.

The flakes of TEXACO Calcium Chloride distributed uniformly over the road gradually disappear and a pleasingly damp, firm, dustless surface results.

Write for full information and prices.

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